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Natural Resources, the Terms of Trade, and Real Income Growth in Canada: 1870 to 2010

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.	not available for any reference period
..	not available for a specific reference period
...	not applicable
0	true zero or a value rounded to zero
0^s	value rounded to 0 (zero) where there is a meaningful distinction between true zero and the value that was rounded
^{p}	preliminary
^{r}	revised
x	suppressed to meet the confidentiality requirements of the *Statistics Act*
^{E}	use with caution
F	too unreliable to be published
*	significantly different from reference category ($p < 0.05$)

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Abstract

This paper studies the growth of the Canadian resource economy and the contribution of trading gains arising from increasing terms of trade to real income growth from 1870 to 2010. It combines a historical account of the growth of a succession of natural resources—examining both the production and price history of agriculture, forestry, mining, and oil and gas—with an overview of the impact of these developments on Canadian well-being. It uses estimates of the difference between real income and real output growth, based on measurement theory from the System of National Accounts, to measure trading gains that arose from increasing terms of trade over the period.

From 1870 to 2010, the cumulative growth in the volume of real gross national income (GNI) due to trading gains is 18% larger than the more common measure of production, gross domestic product (GDP). The pattern is one of a long, initial period of positive growth in the gap between real GNI and real GDP from 1870 to 1920. This was followed by spurts of growth associated with the two world wars that were partly, but not fully, offset by subsequent reversals. The 1970s and the post-2000 petroleum and resource boom continued the long-term trend of an increasing differential between real GNI and real GDP.

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Executive summary

The System of National Accounts (SNA 1993/2008) outlines a number of alternative measures of aggregate output and income that can be used to represent economy-wide economic activity. In practice, most analysts emphasize measures of gross domestic product (GDP)—a measure of aggregate production in the economy.

Alternate measures outlined in the SNA 1993/2008 manuals include real gross national income (GNI) and gross domestic income (GDI). These measures of potential purchases or real absorption differ from real GDP in that they take into account real income gains from sources other than production, primarily the effect of changing terms of trade. In some countries and time periods, the measures of real GDI, real GNI and real production are sufficiently similar that attention tends to focus on only one measure. In Canada, real GDP tends to be the most commonly used. During the post-2000 resource boom, however, Canada's terms of trade changed dramatically and the real GDI, real GNI and real production measures diverged substantially (Baldwin and Macdonald, 2010).

This paper goes beyond the post-2000 resource boom and examines whether there were other times when the summary real income measures yielded different profiles of growth than did output measures. It does so by examining the differences in the two types of measures back to the period just after Confederation. The paper illustrates the usefulness of alternate measures of economic activity, that is, those that take into account non-production sources of real income growth (such as the terms of trade that influence the purchasing power of Canadian income generated by the production process or the flow of primary incomes through the current account). Over long periods of time, real income measures have grown more than the real gross real value added produced in the Canadian economy (real GDP).

The portrait of the extra growth that the non-production sources have generated for measures of Canadian real income is impressive. Since Confederation, the cumulative growth in the volume of national income (real GNI) is 18% larger by 2010 than the more common measure of production, real GDP. The pattern is one of a long initial period of positive growth in the gap between real GNI and real GDP from 1870 to 1920. This was followed by growth spurts associated with the two world wars that were partly but not fully offset by subsequent reversals. More recently, the 1970s and the post-2000 petroleum and resource boom further widened the differential between real GNI and real GDP.

These results also speak to the long-standing debate about the benefits of Canada's resource economy to overall economic well-being. Finding ways to directly measure the connection between an economy's emphasis on resources and overall economic well-being has provided a challenge to much of the discussion about the benefits of resource-based economies. The major source of growth differences between real GNI and real GDP for Canada is the behaviour of its terms of trade. In turn, the behaviour of Canada's terms of trade is directly linked to the relative price of resources. This paper sheds light on how long-run trends in the terms of trade associated with resource dependence have affected Canada's economic growth.

This paper pays close attention to one aspect of this debate: how the terms of trade between Canada's imports and its exports, which have been comprised of mainly natural resources or processed resources, have affected Canadian real income. The study examines the evidence of movements in the terms of trade and how they influenced differences between changes in real income and changes in real GDP.

The paper initially focuses on the evolution of successive waves of resource development and the prices of individual products that make up the terms of trade. Since 1870, a succession of resources has fuelled economic development: agricultural and animal products; forestry (logs, timber, lumber and pulp and paper); non-ferrous metals (zinc, copper, lead, nickel and gold) as well as iron ore, uranium and diamonds; electricity; and petroleum and natural gas.

The paper then moves beyond the richness of historical detail to make use of a summary statistic that cumulates the individual series at the aggregate level to evaluate the overall effect of changes in the terms of trade on well-being. It does so using standard measures arising from the SNA, notably real GNI, to demonstrate that the effect has been substantial.

1 Introduction

The history of Canadian economic development has focused on succeeding waves of exports of raw materials or staples—from fish, fur, timber, wheat, and pulp and paper, to minerals and petroleum products. Canadian economic historians, such as MacIntosh (1925, 1939) and Innis (1933), wove their histories around the limits placed on Canadian economic development by its own geography and the constraints of the U.S.–Canada border; the particular nature of the forward and backward linkages associated with each staple that determined the nature of economic growth; and the evolution of technology, such as particular transportation technologies, that contributed to the exploitation of each successive round of resource development.

Exporting economies that focus on staples have sometimes been seen to be vulnerable to the economic forces peculiar to them. MacIntosh (1939) noted the problems that arose from business cycles, especially when revenues were volatile but costs—such as those borne by 19th-century Canadian governments in the form of infrastructure investments in canals and railways—were fixed. Watkins (1963) noted that the nature of staples development may have affected the entrepreneurial mindset of the country and created a staple export mentality that led the nation into a 'staple trap'.

While Buckley (1958) describes the early focus of investigations as "an economic interpretation of economic changes based on the staple theory" and Watkins (1963) refers to the staple thesis as "history cast widely," substantial efforts have been devoted to measuring the importance of staples to Canadian economic development. The unifying central question is whether the pace of development is determined fundamentally by resource-based exports (Aitken, 1961) or, as Watkins (1963) asked, whether "staple exports are the leading sector, setting the pace for economic growth." Economic historians (Buckley, 1958; Bertram, 1963; Chambers and Gordon, 1966; Keay, 2009) have addressed these questions by examining the relative growth of the resource and other sectors and links between the two.

These questions are not restricted just to the Canadian economy. Deaton (1999) raises a related question about problems associated with the growth of African economies—whether resource booms tend to induce governments to overinvest because they cannot distinguish between short- and long-term trends in relative prices.[1]

Others have asked whether long-run trends associated with resource dependence are beneficial or detrimental to the economic health of a nation. Considerable effort has gone into studying the extent to which a focus on resource staples has led either to a general takeoff (see Rostow, 1951 and Altman, 1987) or to less than robust growth in other sectors like manufacturing (Bertram, 1963, Keay, 2009). In the same vein, Hadass and Williamson (2003) have examined whether resource booms are associated with more or less overall economic growth.

Finding ways to measure the connection between an economy's emphasis on resources and overall economic well-being has provided a challenge to much of the discussion regarding the benefits of resource-based economies (Caves, 1971). The concern about the disadvantages of resource-based economies is manifest in its most concrete form in studies that investigate whether these economies are affected by declining terms of trade. Following the suggestion of Singer (1950) and Prebisch (1950), that the price of raw materials tends to fall relative to

1. The question of volatility is by no means restricted to resource-based economies. The manufacturing sector of the Canadian economy is extremely susceptible to fluctuations in the American business cycle. Baldwin and Macdonald, 2009.

manufactured goods and that economies exporting resources and importing manufacturing goods will suffer from long-run declines in their terms of trade, a generation of economists have devoted themselves to investigating whether there is a 'resource curse' (Ross, 1999).

In contrast, this study shows the positive effects for Canada of its resource-based exports. By looking at current account influences, particularly the long-run developments in the terms of trade that have sprung from Canada's reliance on resource exports, this paper details how real income measures have cumulatively grown 18% more from 1870 to 2010 than the more common real gross domestic product (GDP) output metric.

The paper is organized as follows. Sections 2 and 3 consider the terms of trade and how its impact on overall well-being can be measured using well-developed procedures from the System of National Accounts (SNA). Section 4 contains a brief summary of the evolution of Canadian resources, stressing the successive developments that have occurred in the types of resource staples that have been exploited. It is necessarily focussed only on the development of the resource sector—not because it is intended to argue that the economy was unduly concentrated only on staples, but because it is essential to have the historical details in mind when interpreting the aggregate data contained in the subsequent sections. Section 4 discusses both individual developments and provides an overview of changes in the staple mix. Section 5 examines the evolution of the Canadian balance of payments with an emphasis on the role of resources in exports. Section 6 investigates long-run movements in the relative prices of exports and imports along with estimates of the terms of trade over sub-periods between 1870 and 2010.

Sections 7 and 8 contain estimates of the effect of the changing terms of trade on the real income of Canadians. They focus on the long-run evolution of the overall effect of trading gains that occurred as a result of rising relative export prices (Section 6) and the impact of trading gains on differences in measures of output (GDP) and measures of absorption possibilities (gross domestic income [GDI] and gross national income [GNI]) to encapsulate the overall impact of the terms of trade (Section 7). While others have focussed on the evolution of the prices of individual products when studying the terms of trade, none has cumulated the individual series together at the aggregate level to evaluate the overall effect of changes in the terms of trade on well-being using officially recognized measures from the 1993 SNA. The importance of doing so is made evident from the history contained in Section 5. The prices of all export products rarely move together. Similarly, import prices may sometimes move downward at the same time as export prices, but it is the relative movement of the two that matters for changes in the terms of trade. Finally, the net effect of movements in the terms of trade depends not just on the movement in relative prices but also on the movement in quantities.[2] Summary statistics capturing overall aggregates such as GNI or GDI allow for the net impact of changing relative export and import prices on well-being to be encapsulated in a single summary statistic.

2 The importance of the terms of trade

Until recenty, the terms of trade—the price of exports relative to the price of imports—has not been commonly used to evaluate long-run improvements in Canadian living standards.[3]

2. See Viner (1937).
3. Canadian studies that cover short periods of time can be found in Mitchell and Taylor (1931), Macintosh (1939), Reuber (1949) and Cross (2004).

Terms of trade determines the number of imports that each export can purchase. When the terms of trade rises, exports can be exchanged for more imports, in effect raising real incomes and boosting domestic spending.

The importance of improvements in the terms of trade can be understood more clearly by recognizing that there are two channels through which the resources of a country are transformed into goods and services available for use.

The first is domestic production, which occurs when a country transforms its own resources into goods and services. Success here is measured by real GDP.

The second channel occurs via trade, by exchanging exports for imports. On balance, Canada exports resources and imports manufactured products. When resource prices increase or when the price of manufactured products declines, the number of imports that can be purchased with exports increases.

Previous historical studies that have examined the terms of trade have focused on measuring the prices of imports and exports directly (Imlah, 1950; Reuber, 1959; Kindleberger, 1955, 1958; Bambrick, 1970). This has involved painstaking work transcribing what are often hundreds of price series.

Focussing only on relative prices of exports and imports also entails several other well-known difficulties. Simply comparing changes in the net barter terms of trade ignores the fact that goods exports are also exchanged for services or 'invisibles' (Taussig, 1925). The net barter terms of trade also ignores international flows of income related to the capital account (Molodowsky, 1927). Taking into account the capital account is important because the relative price of exports influences the amount of resources that needs to be traded both for imports of goods and for the income outflows needed to pay for imports of capital. Finally, the benefits that an economy obtains from exchanging exports for imports depends ultimately not just on relative prices but also on quantities, since changes in export prices may be associated with a decline in demand (Harrod, 1933; Haberler, 1936; Viner, 1937). Examining the terms of trade alone does not take into account the quantity of goods being traded; it is a price index, not a quantity index.

Studies of terms of trade have focussed on the long-term fate of economies that either export raw materials or import manufactured goods. One explanation positing a long-term trend in the terms of trade of these different types of economies relied not only on the possibility of diminishing returns to agricultural production but also on increasing opportunities for scale economies and other productivity-enhancing innovations that would cause a relative decline in the price of manufactured goods (Clark, 1940).

Research has failed to confirm that manufacturing economies have generally suffered from falling terms of trade or that resource-based economies experience the reverse. Neither theory nor empirical evidence suggests one particular path for the terms of trade of countries that rely on exports of either natural resources or manufactured products. The trend in resource prices depends on the interplay of movements in the extensive boundary that determines production loci and in advances in technology. Changes in export prices depend in a complex way on several

factors: the elasticity of supply in different sectors, shifts in demand occasioned by economic growth, increases in real income and changes in government policy.[4]

When these characteristics are considered, there is little reason to presuppose that inelasticities of supply are any more likely to dominate resource economies than manufacturing economies. And there is no lack of evidence that resource industries experience productivity improvements. Studies by Moore (1941) and Main (1955) have emphasized that productivity advances in Canadian mining have affected mining output: technological advances pushed down prices of non-ferrous metals as more complex ores were produced. From 1935 to 1952, Canadian labour productivity increased by 140% in agriculture and 33% in mining, both higher than the 26% in manufacturing (Pentland, 1954). After the Second World War, productivity gains in the Canadian mining sector continued to be significant (Stollery, 1985). In oil exploration, the technological progress made has also been substantial (National Petroleum Council, 2007). Productivity gains have been greater in agriculture than in manufacturing over most of the post-Second World War period (Baldwin et al., 2001).

Manufactured goods have not been found to be subject to continuously declining prices: rather, it has been noted that the extensive resource margin could also influence price movements of manufactured products. For example, the inelasticity of the U.K. coal supply during times of rapid increase in the demand for steel in the late 19th and early 20th centuries led to sharp rises in steel prices (Rostow, 1951).

Empirical studies have not found that resource prices and manufactured prices necessarily move in opposite directions. Both the price of cotton delivered to the United Kingdom and the price of textiles exported from the United Kingdom fell after 1815 (Imlah, 1950), confirming the difficulty of generalizing the nature of long-term trends in economies depending on raw materials or manufactured goods. Kindleberger (1958) summarizes the empirical evidence in this area and concludes that there is so much variability in the response of supply to demand stimuli that generalizations are inappropriate regarding differences between more and less industrialized economies. And in comparing the terms of trade experience of the United Kingdom to other European countries over the period 1870 to 1950, Kindleberger (1955) argues that there is no single pattern even across European countries. Morgan (1959) also reports a wide diversity of experience across countries.

Evaluation of the Canadian experience then addresses questions that have held the attention both of Canadian historians and development economists in general. The Canadian experience provides us with the opportunity to examine the impact of resource exports on an economy that has developed a wide range of resources: agricultural, mining, forestry and petroleum. It is a country characterized by strong cultural and geographic connections that enabled it to access and adopt technologies from more developed nations—first Britain, then the United States. In both cases, this facilitated access to finance and technology. Canada's democratic traditions and a rule of law gave protection to private property and facilitated the development of a market economy. The political system also proved capable of financing public infrastructure development when required.

Previous studies of other countries have been hampered by two difficulties. The first is the lack of the large number of data series that are needed to compare the prices of exports and imports over long periods. Canadian data are available from both official sources and academic studies

4. The repeal of the *Corn Laws* in the 1840s improved the profitability of overseas wheat production, while the removal of Imperial Preference for Timber during the same decade reduced the competitive advantage of Canadian timber in U.K. markets.

for this purpose. The second is the lack of agreement on an index that can be used to measure the overall impact of changes in the relative prices of exports.

The next section outlines the methodology employed by the SNA that overcomes some of the shortcomings in the approaches that simply examined commodity net barter terms of trade or simple ratios of imports to exports. The SNA approach answers the essential question that is at the heart of debates over the advantage or disadvantage of a resource-based export economy: how have changes in the terms of trade for resources increased the real income of Canadians?

3 The difference between real gross domestic income and real gross domestic product

3.1 Concepts

Although understanding the trajectory of the prices of individual commodities illuminates the basic causes of changes in the terms of trade, it is not necessary to do so for estimating the extent to which relative price changes affect the economic well-being of a country. This section explains the rationale for the alternate approach used here—measuring the impact of resource exports as the difference between real income and real GDP.

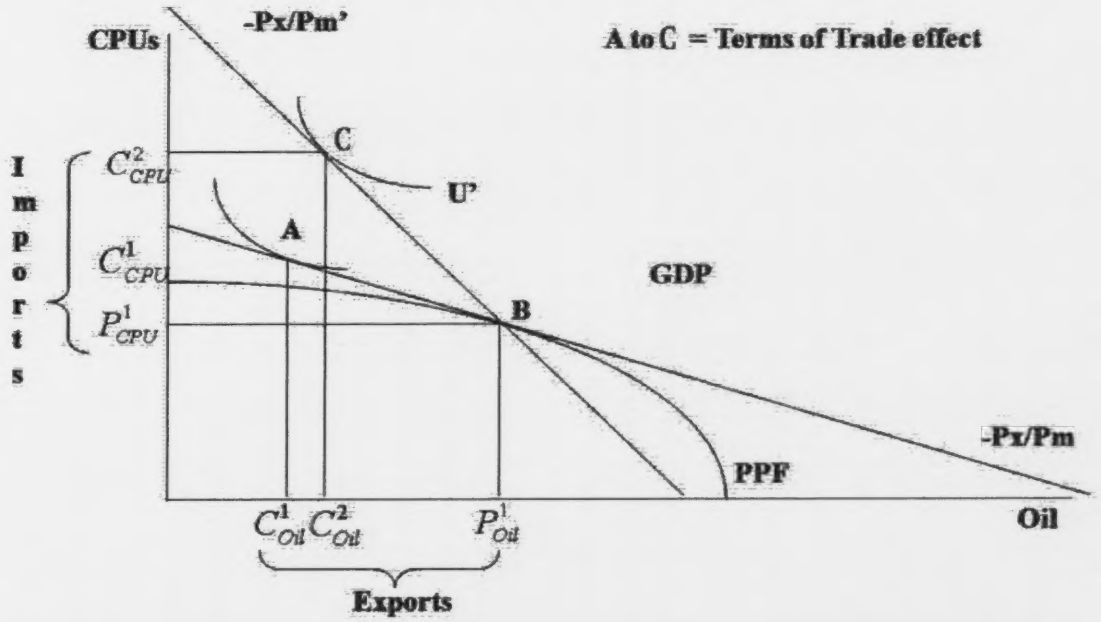
Summary measures of aggregate activity are often used to describe the performance of an economy. These measures can be based on concepts of domestic production or domestic absorption—the extent to which goods and services are produced or are available for consumption and investment. The most commonly used measure of aggregate economic activity is real GDP. Real GDP is a summary measure of the volume of aggregate economic activity associated with production. It represents the value added generated by workers and investors through the production process.

Real GDI is an alternative real income measure used in the SNA that is related to an economy's ability to purchase goods and services. It is a measure of economic activity associated with domestic absorption as opposed to domestic production. Rather than focussing only on production, real GDI also accounts for changes in the purchasing power of production (real GDP). Real GDI, therefore, moves the analysis to an income concept that accords with the goods and services that an economy can use for consumption and investment instead of the goods and services that an economy produces.

Real GDI is a measure of real income that adjusts output for improvements in purchasing power arising from increases in export prices relative to import prices. Using the difference between real GDI and real GDP measures to evaluate increases in well-being addresses one of the major criticisms of terms-of-trade statistics—that they measure only relative prices and not quantities or simple ratios of quantities, nor real income. An increase in a country's exchange rate because of rising interest rates can lead to an increase in the terms of trade: but it may also lead to lower export volumes, depending on the demand elasticity in foreign countries. Real GDI provides a measure of the change in the volume of real income available for absorption that takes into account changes in the volume of exports and the prices of this output.

The 1993 SNA details how to calculate this purchasing power measure. The difference between real GDP and real GDI measures how the changing relative prices of imports and exports affect an economy. Real GDP and real GDI will only be equal if a country does not engage in trade. If a country trades with other nations, trade patterns and relative price changes can lead to differences between how much an economy can purchase (real GDI) with what it earns through production (real GDP).

Figure 1
Impact of improvements in terms of trade



Note: The figure shows the impact of terms of trade improvements on the utility function of a representative consumer. In the initial situation a Production Possibilities Frontier (PPF) delineates the possible levels of oil and computers that can be produced by re-allocating resources from one activity to the other. The optimal production combination of oil and computers is the one that allows for the highest level of consumption. The consumer's utility function is the basis for optimizing welfare, but instead of being tangential to the PPF, the marginal rate of substitution is equal to the price of exports relative to the price of imports (the terms of trade). The highest level of utility is achieved at the point where the terms of trade are equal to the rate of substitution between production of oil and computers. The optimal level of consumption is labelled point A. The optimal production levels occur at point B. The difference between oil produced and consumed is equal to the value of exports. The difference between computer production and consumption is imports.

If the price of exports rises relative to the price of imports then at current production levels it is possible to trade the existing export stream for more imports, or keep some the oil that would be exported for consumption without lowering imports. Both choices would be welfare enhancing. On the figure, a terms of trade improvement raises the optimal consumption point from A to C. Production remains unchanged in the short run, so the budget constraint rotates through point B. Because of the terms of trade improvement a higher level of utility is achieved without any additional production.

There are two reasons why changing relative trade price ratios can lead to a divergence between real GDP and real GDI. The first, and most important, stems from changes in the terms of trade—the relative price of imports and exports. The second is the changes in the relative price of traded to non-traded goods, which has been termed the 'real exchange rate' (Salter 1959). Importantly, this is not the real exchange rate commonly employed in macroeconomics. The real exchange rate here compares domestic prices (from final demand) with traded prices (an average of export and import prices) rather than adjusting a nominal exchange rate for differences in national price levels. The effect of this real exchange rate depends both on the changes in domestic versus export and import prices, and on the importance of traded goods in the economy. The combination of the two effects generates a trading gain that captures the changes in purchasing power for domestic economic agents resulting from trade activity in a world of changing relative prices.

The effect of changes in the terms of trade on an economy is shown in Figure 1. In this scenario, a country maximizes its welfare by producing and consuming oil and computers, and also exchanges some oil for computers (CPUs) in international trade. Additional units of each good

are consumed until the marginal rate of transformation between oil and CPUs equals the terms of trade. Based on the set of preferences contained in the representative utility curve U, and the terms of trade, agents allocate productive resources in the economy to reach the highest possible utility curve—where the ratio of the opportunity cost of producing oil compared with computers is equal to the terms of trade. At this point, the slope of the production possibilities frontier (PPF) is equal to the negative of the terms of trade and the negative marginal rate of substitution along the agent's utility curve. In Figure 1, these conditions are met when the economy produces at point B and consumes at point A.

When terms of trade change, say, because computer prices decline due to rapid productivity growth in the country's trading partner, then the agents of the hypothetical economy can move to a higher level of utility by reorganizing their trade activity to take advantage of the terms of trade improvement. The representative agent moves from consuming at Point A to consuming at Point C. Since economic theory and statistical practice dictate that nominal GDP and nominal GDI are equal, in Figure 1, nominal GDP is equal at all points so that nominal income is the same at points A, B and C. However, the economy is able to consume more because the value of its exports increased relative to its imports.

Terms-of-trade effects are often not well recognized because their impact can only be interpreted in inflation-adjusted data. Nominal estimates for GDP and GDI will not show an identifiable effect from terms-of-trade changes because, in current dollars, their impact is subsumed in changes in the balance of net exports. When inflation is accounted for, real GDP reflects the volume of output produced measured in terms of the prices of production: when the volume of goods and services produced rises, real GDP rises.

In nominal terms, GDP and GDI are equal. Real GDP and real GDI differ only in terms of the deflators used to create a volume index from nominal values of these two aggregate measures of economic activity. The volume index of GDP is measured by deflating each of the individual components of GDP by the price index that pertains to it. The measure of real GDI differs in that it allows relative price changes to affect the volume of traded goods and services that may be purchased. The deflator used to create the volume index of GDI achieves this by using the same price index for exports and imports. This approach is equivalent to deflating net exports rather than exports and imports separately. By deflating net exports, the GDI deflator captures changes in purchasing power that originate from trade activity. Rather than capturing only the volume of exports and imports entering and leaving the economy, the GDI deflator produces a real income metric that captures the volume of imports that can be purchased with a given volume of exports.

In this paper, a final domestic expenditure (FDE) price index is used as the deflator. It represents average movements in consumption, investment and inventory prices.[5] To understand the rationale for this deflator, note that GDP when measured at the industry level—what is called 'value added'—is equal to the final value of all goods and services sold on markets, net of intermediate inputs used in production or the income that accrues to capital and labour in each period. Thus value added and the income approach to measuring GDP are equivalent. GDP is also measured as the set of final expenditures by agents in an economy—the value of final sales (consumption plus investment plus government less import purchases) that equals the income produced by domestic production.

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5. Dennison (1981) followed Dorrance (1948) in deflating net exports using an import price index. For a historical discussion of alternate price deflators that begins with A.L. Bowley (1944), see the appendix in Denison (1984).

It can be shown[6] that real GDI growth is real GDP growth plus the weighted sum of adjustments for changes in the real exchange rate (*E*) and the terms of trade (*ToT*):

$$d\ln(y_{GDI,t/t-1}) = d\ln(y_{Y,t/t-1}) + \left[(\bar{v}_X - \bar{v}_M)\{d\ln(E_{t/t-1})\} + \frac{1}{2}(\bar{v}_X + \bar{v}_M)\{d\ln(ToT_{t/t-1})\} \right], \qquad (1)$$

where *X* and *M* represent exports and imports, and the weights are defined as:

$$v_{i,t} = \frac{\gamma_i}{GDP} \quad \gamma_i = X, M \text{ ; and}$$

$$\bar{v}_{i,t/t-1} = \frac{(v_{i,t} + v_{i,t-1})}{2} \quad i = X, M .$$

The weights attached to changes in the real exchange rate and the terms of trade have economic significance. The real exchange rate weight, $(\bar{v}_X - \bar{v}_M)$, is positive (negative) when the trade balance is in surplus (deficit), while its magnitude captures the size of the surplus (deficit) relative to nominal GDP—the net trade balance. The weight attached to terms of trade growth, $\frac{1}{2}(\bar{v}_X + \bar{v}_M)$, is the average value of trade as a proportion of nominal GDP—the gross trade balance. As a result, real GDI in countries that are more open to trade is more susceptible to shifts in terms of trade, and a larger trade imbalance makes real GDI more susceptible to real exchange rate movements.

Of the two relative price ratios, the terms of trade is the more important for understanding changes in purchasing power. It is subject to larger fluctuations in Canada than the real exchange rate, and has a larger impact because it is related to trade openness. The impact of the real exchange rate effect is proportional to the net trade balance in GDP, and so it has a much smaller impact on real income fluctuations, since

$$\left(\left| {}^{(X-M)}/_{GDP} \right| \leq {}^{(X+M)}/_{GDP} \right). \qquad (2)$$

Movements in the terms of trade and the real exchange rate are not independent of each other. For example, a nominal exchange rate depreciation can worsen a country's terms of trade and simultaneously improve its real exchange rate. They can reinforce or dampen each other's effects depending on the type of price movements and their sources.

Measures of both real GDP and real GDI are based on the aggregate income produced within the Canadian economy. An extension that takes into account international income transfers produces the aggregate income measure called 'real GNI', formerly called real GNP. GDP captures the total value of income produced within the territorial boundary of a country; GNP captures the total value earned by Canadians whether inside or outside the country. A difference between real GDI and real GNI arises when Canadians invest or work abroad and foreigners invest or work in Canada. The wages and salaries paid to foreign workers, or the dividends and interest payments made to cross-border investors, lead to a flow of income across jurisdictions that raises or lowers real income growth accruing to Canadians. Subtracting (or adding) these net flows from (to) GDI produces GNI. The resulting transfer of factor incomes between Canadian and foreigners—

6. See Appendix, section 10.5.

essentially, claims on their respective GDPs—raises or lowers real GNI depending on whether Canada is in surplus or deficit with respect to these flows. Real growth in GNI (sometimes called GNP) is derived by deflating nominal GNI by the final expenditure deflator, for the same reason it is used to derive real GDI.

The use of GNI rather than just GDI allows for consideration of both the trade flows associated with goods and services and the income flows associated with international capital flows. GNI also provides a more complete measure of the impact of changing relative prices for exports and imports. The measure is both more complete and more appropriate for measuring overall well-being in an export-based economy that raises capital abroad for this activity. Growth in the Canadian resource economy has often required borrowing large amounts of capital that were repaid over a long period of time, at terms that were fixed, at least in the short run. Payoffs depended on the course of the terms of trade, against which there were few hedges available. As Macintosh (1939) and Plumptre (1937) emphasized, investing in infrastructure and borrowing foreign funds to finance this activity involved a bet on future resource prices, the outcome being fortuitous when resource prices increased and ruinous when the reverse occurred.

4 Canadian growth

4.1 The evolution of natural resource production

This section briefly sketches the evolution of Canadian natural resource production. Graphs of production volumes by commodity are provided in the Appendix, section 10.4. The sketch focuses primarily on agricultural, forestry, mining and oil products, and how successive waves of natural resources have played a role in Canada's development. These resources have provided a staple base for exports that facilitated development of the Canadian economy both by paying for imports of capital goods and of intermediate materials needed for investment and also by paying for the inflow of capital needed to finance the expansion. The exports consisted of raw materials and goods processed into manufactured products (e.g., bacon, cheese, lumber, paper and metals). A large part of the manufacturing sector performed a processing function that depended on the resource base, such as the smelting of non-ferrous metals like copper, gold and zinc, the processing industry that transformed wood chips to pulp and paper, and the aluminum industry that relied on cheap electric power derived from water resources to turn bauxite or alumina into aluminum.

Throughout this period, Canada possessed a small population endowed with a large land mass containing an assortment of resources. Developing these resources has depended on the demands of its trading partners, on the technologies available (both for the reduction of transportation costs that affected the netback received for exports and the technologies available for extraction that shifted the supply possibilities curve) and on government intervention that negotiated access to foreign markets when political considerations restricted sales of Canadian resource exports. As a result, the composition of the resources that Canada has produced has changed over time. Moving from furs and fish to wheat, cattle, forestry, mining, oil and gas, Canada has progressed along a path that developed successive extractive industries requiring advances in technological proficiency at each stage.

The period from around Confederation to the early 1890s was one of slow growth. By North American standards, population increases in Canada were relatively slow—15%, 17% and 12% over the decades 1861-71, [a] 1871-81, and 1881-91[b] compared with growth rates of over 25% per decade[c] in the United States during the same period.

The federal government established the basis for western expansion by purchasing Rupert's Land in 1870 and building the Canadian Pacific Railway through the Prairies to British Columbia in the 1880s.

With the first of the western railways in place, the period from 1895 to 1920 was characterized by rapid expansion (Bertram, 1963; Rostow, 1951). From 1901 to 1921, the population grew by 64% and farm area by 125%.[d] Wheat production grew 714% from 1880 to 1920.[e] Expansion of wheat production was facilitated by numerous technological advances—including dry-farming methods, the application of new forms of mechanization and the introduction of hardy wheat varieties. Wheat flour production benefited from the introduction of Hungarian rolling milling technology.

This was also an era in which the production of other staples increased dramatically. While the value of field crops increased by 400%, the value of wood and paper products rose 900%.[f] In 1913, Canadian newsprint production was less than 20% of U.S. production, but by 1925 had surpassed the latter. By 1939, it was over 3.5 times as large.[g] Newsprint production, which was less than 300,000 tons in 1913, had reached more than 3,600,000 tons by 1937.[h]

The late 1890s and early decades after 1900 heralded a period of rapid expansion of mineral production. Exploitation of the silver–lead–zinc deposits in British Columbia and the nickel–copper deposits in Sudbury began in the late 1890s; in the next two decades, the silver deposits in Ontario at Cobalt and the gold production in Ontario at Porcupine and Kirkland Lake followed. Gold and copper production, which was less than 3% of world production in 1910, rose to over 13% by 1939.[i] Canadian lead and zinc production experienced similar percentage point increases. Canadian nickel production, which accounted for around 75% of world production in 1910, increased from 37,000 lbs to more than 227,000 lbs by 1939, and accounted for close to 90% of world production.[j]

This expansion led to a change in the composition of exports. In 1890, the leading exports comprised sawmill products, cheese, fish, cattle, nickel and copper. By 1920, wheat and wheat flour had become the leading export. Cattle, fish and cheese were still important, but primarily as a result of wartime demands. The rapid growth period from 1900 to 1920 culminated in dramatic growth in exports as a result of The First World War (1914 to 1918).

Rapid investment in the railway infrastructure in the post-2000 period required large amounts of imported iron and steel (Buckley, 1958). Foreign capital invested in Canada increased by over 400%[k] from 1901 to 1921, and foreign debt servicing costs increased concomitantly.

The First World War was associated with dramatic increases in resource production. The value of wheat exports from 1917 to 1919 was some 100% higher than in 1913.[l] Exports of the new staples also increased dramatically: nickel, copper, lead and zinc rose from $14 million in 1911 to $26 million in 1921;[m] wood pulp and newsprint, from $19 million in 1913 to $150 million in 1921.[n] Canadian mineral production increased from $129 million in 1914 to $211 million in 1918; steel from 1 million to 2.25 million ingots over the same period.[o]

The 1920s commenced with a dramatic post-war depression, giving way to a gradual increase in resource output over the decade. Wheat exports to Europe continued to grow, partly because the traditional supply from Europe was reduced following the Russian revolution. Output was also bolstered by record yields on the Canadian Prairies. By the late 1920s, Canada accounted for over 50% of world wheat exports.[p]

Demand for forestry products grew dramatically because of the rapid urbanization in the United States, the concomitant need for building materials, and because of the expansion of daily newspapers and their demand for newsprint. Pulp production increased steadily in the 1920s and 1930s. By 1939, over 90% of exports went to U.S. markets.[q] Newsprint volumes grew even more

rapidly than pulp over this period. Exports of lumber from British Columbia to eastern U.S. markets increased after 1925 with the opening of the Panama Canal, which dramatically increased netbacks received for lumber produced in British Columbia.[r]

Production of base and precious metals continued to grow as refining technologies permitted the exploitation of increasingly complex ore bodies (Skeleton, 1947). Aluminum production expanded to the Saguenay in Quebec along with the development of hydroelectric power (Dales, 1957). Base metals and gold had increased their relative importance compared to wheat—but wheat, wheat flour, pulp and paper, base metals and gold continued to make up more than half of all exports.[s]

The 1930s experienced a dramatic decline in agricultural production at the beginning of the decade that only slowly regained late-1920s levels as the decade progressed.

Inappropriate production methods that tilled the soil too deeply, combined with poor weather, resulted in dramatic declines in farm incomes. For many crops, the number of seeded acres remained fairly stable, but yields declined and so production declined steeply. In 1929, there were 24 million acres seeded, which yielded 557 million bushels of wheat.[t] In 1932, 26 million seeded acres of wheat yielded 321 million bushels of wheat; in 1938, 26 million acres produced only 180 million bushels of wheat. From 1929 to 1938, wheat yields fell from 23.5 bushels per acre to 7, a decline of 70%. Other grains followed suit: oat yields fell 40%, barley, 31%, rye, 63% and flaxseed, 66%.[u]

At their worst point during the Great Depression, cash income from farm products fell to $409 million from a pre-depression level in 1929 of $932 million, a 56% decline.[v]

Exports of crops declined sharply through the 1930s, because of restricted supply as yields fell and reduced demand in the United States (where unemployment reached 25% in 1933). Wheat exports fell roughly 50% between 1929 and 1932[w] and remained weak through most of the 1930s. Wheat exports did not regain late-1920s levels until the late 1950s. Oats, barley and rye recovered similarly, but more rapidly than wheat.

Livestock producers did not fare as poorly during the 1930s as did crop producers. However, the deflation of the 1930s eroded the value of their stocks. From 1929 to 1934, the number of cattle and calves rose 21%, but their stock value declined 55%. By 1938, the stock of cattle and calves was 13% higher than it was in 1929, but its value was 37% lower.[x] Exports of livestock products saw steeper declines with the onset of the depression than did production numbers, as U.S. demand declined more rapidly than did Canadian production. However, by the latter half of the 1930s, the United States resumed importing livestock from Canada.

Pulp and paper also declined early in the decade, but then resumed its steady growth—resulting in an oversupply that caused the governments of Ontario and Quebec to prorate production in order to support prices. Growth in both pulp and newsprint was very rapid by the end of the 1930s.

After a fall in the early years of the decade, non-ferrous metals (copper, lead, zinc and nickel) grew rapidly. Gold production, which had started its rapid growth phase in the early 1920s, continued to grow rapidly throughout the 1930s. Gold production was stimulated by the revaluation of the U.S. dollar from $20.67 to $35 with the passing of the *Gold Reserve Act* in January 1934. The revaluation had the effect of generating a small gold rush in Canada, which increased production by 2.1 million ounces, or 72%, from 1933 to 1939,[y] and drove a rapid increase in gold exploration that included the discovery of what became the Giant Mine in Yellowknife in 1935.

The Second World War was accompanied by the expansion of traditional foodstuffs but also non-ferrous metals and oilseeds to serve wartime demands.

After 1945, the Canadian economy grew rapidly along with rapid expansion in U.S. industrial capacity. Forest products responded to the post-war housing expansion in both Canada and the United States. Pulp and paper expanded rapidly with the growth of newspaper circulation. By 1950, Canada supplied over half of the world's newsprint.[z] By 1954, it accounted for 24% of Canada's exports—and 33% of those to the United States.[aa]

Non-ferrous metals also expanded during the early post-war years to serve growing North American industrial demands. Substantial growth occurred in Ontario in the immediate post-war period in iron ore, nickel, cobalt, copper, uranium and gold. Saskatchewan uranium production grew rapidly. Quebec experienced growth in asbestos, gold, copper, lead and zinc. Manitoba saw the development of nickel deposits at Flin Flon in 1954. The development of Labrador's iron mines in 1954 was led by a consortium of Canadian and U.S. companies, as the Mesabi iron deposits in the United States gradually proved unable to keep up with the demands of the North American steel industry. The building of new infrastructure—notably the St. Lawrence Seaway—facilitated the development of this new Canadian supply needed by the steel industry. After a hiatus during the Second World War, growth of gold production resumed in response to monetary demand. Aluminum production also expanded both in British Columbia, at Kitimat in 1954, and in the Quebec Saguenay region to serve the rapid expansion of the world aviation industry in the post-war era.

As was the case with inter-war developments of pulp and paper, non-ferrous metal industries and aluminum, expansion in each of these areas was supported by a rapid growth of electrical capacity that depended on water resources. Installed central hydro capacity had grown by 3.3 million kwh in the 1920s; from 1945 to 1955 it grew by almost twice as much, 6.3 million kwh.[bb] Dales (1957) has emphasized that exploitation of hydroelectric power was an important complementary input used in the production of three main staple exports (pulp, paper and minerals) in the inter-war period, and continued to be so after 1945.

While minor changes occurred in the identity of the leading exports, Canada remained focussed on resource exports over this period. In 1926, the leading exports by value were wheat, newsprint, wheat flour, planks and boards, wood pulp, barley, fur, whiskey, farm implements, copper, pulpwood and lead. By 1951, the leading exports were wheat, newsprint, planks and boards, wood pulp, aluminum, nickel, barley, wheat flour, copper, zinc, farm implements and asbestos.[cc]

Energy became the new staple in the resource landscape after 1945. Until this time, Canada had relied on coal imports, though some local sources were available on the Prairies and in Nova Scotia, and small amounts of oil and gas served local Prairie markets. But the major oil discovery in Alberta at Leduc in 1947 led to a dramatic expansion of crude oil and natural gas reserves. And, as was the case with the wheat economy, some half a century earlier, an infrastructure building program was begun to deliver the new staple first to domestic and then to foreign markets. The interprovincial pipeline was built east from Alberta, bringing crude oil to Ontario in 1951; Transmountain Pipeline was built west to British Columbia in 1953. Westcoast Pipeline began delivering natural gas to Vancouver in 1957 and Transcanada Pipeline brought natural gas to eastern Canada in 1958.

Commencing in 1961, the National Oil Policy ensured a market for western oil by requiring that all refineries west of the Ottawa Valley use western oil inputs. The construction of pipeline infrastructure and a concerted national policy led to an increase in oil production in Canada from 195 million barrels in 1960 to 622 million barrels in 1972, an annual compound growth rate of 9.5%. The increases in production during the 1960s correspond with the period when Canada

became an energy exporter, going from net imports of 66 million barrels in 1961 to net exports of 60 million barrels in 1972.[dd]

The 1973 Organization of Petroleum Exporting Countries (OPEC) oil embargo, generated rapid energy price increases across the world. The price of Brent crude oil rose from US$2.48 per barrel in 1972 to US$11.58 per barrel in 1974, an increase of 367% in two years; the price per barrel of West Texas Intermediate (WTI) rose 87%, from US$4.91 in 1972 to US$9.18 in 1974. The immediate response of Canadian oil producers was to boost production from 622 million barrels in 1972 to 716 million barrels in 1973.[ee] However, the production increases were not sustained: production fell back to an average of 565 million barrels per year from 1974 to 1978.[ff] Natural gas production, after rising rapidly from 1951 to 1972 from 75 billion cubic feet to 323 billion cubic feet, levelled off at an average of 350 billion cubic feet from 1973 to 1984.[gg]

The second oil shock in 1979 saw an increase in crude prices. Canadian production did not respond as strongly to the second oil shock as it had to the first, in part because of the National Energy Program (NEP), instituted on October 28, 1980. The NEP directed Canadian oil and gas to Canadian consumers at rates below world prices for energy commodities. It lasted until 1984/1985, when it was eliminated by the Western Energy Accord. Energy prices were deregulated in 1985 and the borders were re-opened to trade in energy products.

The cessation of the NEP occurred just before the 1986 energy price collapse. Despite a weakening of energy prices, production and export values increased through the 1980s and 1990s for oil and natural gas. Weak energy prices, particularly during the late 1980s and early 1990s when Brent crude and WTI prices sank below US$15 per barrel reduced the incentives for oil and gas extraction. Nevertheless, energy companies in western Canada, particularly in Alberta, continued to expand their production and export capacities. The non-conventional oil extraction operations begun by Syncrude at Fort McMurray in 1978 expanded and began to supplant conventional oil extraction. By the first decade of the 2000s, they became the primary source of new oil for Canada. The 1990s also saw the expansion of energy production outside of Alberta, as offshore deposits on the East Coast came online and energy production rose in British Columbia, particularly of natural gas.

The resource boom after 2000 led to a resurgence in energy production investment in Canada and expansions of energy production in all provinces with energy reserves.

Forestry output and exports continued to grow through the 1970s, despite the economic disruptions caused by the first and second oil shocks. Production of sawn lumber increased rapidly in British Columbia; by the late 1960s and early 1970s, British Columbia accounted for nearly 70% of sawn lumber. That share declined into the early 1980s: at the onset of the softwood lumber dispute in 1982, British Columbia accounted for 63% of sawn lumber.[hh] The 1982 dispute, and the successive rounds of negotiations and agreements that followed, led to a reallocation of production across Canada. In particular, British Columbia would see its share of sawn lumber production decline from 63% to a low of 44% in 1999, 2001 and 2002 as Quebec, Nova Scotia and New Brunswick increased their shares.[ii]

The North American Free Trade Agreement (NAFTA) removed many of the trade barriers for Canadian producers in U.S. markets. Export volumes of forest products increased at a compound annual rate of 4.4% between 1990 and 2000, more than doubling the growth in forest products exports of 1.7% through the 1980s.[jj] At the same time, forest product export prices rose at a compound annual rate of 3.2% per year, which outpaced the 2.3% compound annual growth in goods export prices.[kk]

The rise of the Internet, falling newspaper circulation, increased distances between extraction sites and mills and deregulation of electricity markets in Ontario produced adverse conditions for

forest producers through the late 1990s and 2000s. Pulp and paper firms began closing plants because of falling demand and weak prices. Pulp production declined from 27 million tonnes in 2000 to 17 million tonnes in 2009. Newsprint followed a similar pattern, declining from 9 million tonnes to 4 million tonnes.[ll]

Lumber production temporarily filled the gap in forestry production in response to the U.S. housing boom of the mid-2000s. However, when that boom collapsed in 2007, lumber production and forest product exports declined rapidly as demand weakened and prices fell sharply. Forestry product export prices declined at an annual compound rate of 2.9% from 2000 to 2009; the largest declines of the decade were -6% in 2007 and 2009.[mm] The volume of forestry exports declined at a compound annual rate of 5.6%. Sawn lumber production was 45 million cubic meters in Canada in 2009, a level not seen since the early 1980s.[nn]

By the 1970s, production of many of Canada's major metals had reached their peak. For nickel, copper, zinc and iron ore, the 1970s were the high points for extraction.[oo] Significant discoveries from the 1950s and 1960s had been brought online. Through the 1980s, new minerals such as uranium and potash increased production. Gold production and exploration increased following the collapse of Bretton Woods in the early 1970s and the move by major economies to fiat currencies. Strong gold prices, which peaked at an annual average around US$600 an ounce in 1980, stimulated gold investment and brought about rapid increases in production. From August 1980 to August 1990, gold production in Canada increased by 327%.[pp]

Weak minerals prices through much of the 1990s held back mineral exploration, leading to declining reserve-to-production ratios for most metals and minerals (Cranstone, 2002).

Through the second half of the 20th century, crop yields in Canada increased steadily from the lows of the 1930s, spurred on by improvements in seed varieties, fertilizers, pesticides and herbicides as well as farm equipment. In this regard, research and development in agricultural markets has been instrumental in improving the volume and diversity of produced and exported agricultural commodities. Wheat and barley continued to be Canada's major grain commodities.

The 1960s and 1970s saw expansions of Canada's agricultural export markets, as the USSR and China became important destinations for Canadian grains. In China's case, the relationship began in 1961 when China signed its first long-term contract with the Canadian Wheat Board. The precedent set by the 1961 agreement facilitated the development of important trade ties between Canada and China to the point where, in 1971, Canada was the sole supplier of wheat to China. Since the 1970s, China's internal capacity to produce wheat has increased to satisfy internal demand, but it remains an important market for some types of Canadian milled wheat and for Canadian barley.

The Second World War saw increased plantings of oilseeds that were stimulated by war demand for lubricants, and increased plantings of beans. After the war, Canada continued to increase its oilseed and bean acreage and invested in oilseed research. The development of canola (**Can**adian **o**il, **l**ow **a**cid) in the early 1970s (McInnis 2004) was a major milestone for Canadian oilseed production. Over the period spanning 1946 to 2009, crop production increased most rapidly in oilseeds and beans.

Animal products also continued to expand through the 1970s and 1980s, as Canadian exports of cattle and hogs to the United States increased. The temporary banning of Canadian cattle products by the United States in response the discovery of bovine spongiform encephalopathy in Alberta in 2003 led to a large decline in exports. The partial re-opening of the border to animals in August 2003 alleviated some of the pressure on ranchers, but the border was not fully re-opened until 2007.

The post-2000 period is characterized by a significant resource boom. Energy exports expanded to surpass those of forestry products, partly because of a significant global growth in the former and partly because of the gradual decline of paper exports due to declining newspaper circulation. In the energy sector, natural gas exports began to surge in the late 1990s (Cross, 2007) and were followed by rapid growth in new sources of crude petroleum production as heavy oil was developed from the oil sands in Alberta and conventional sources of oil declined. New sources of offshore oil off Newfoundland that were discovered in the 1980s and natural gas off Nova Scotia were also brought into production.

4.2 Trade policy developments

Growth in the Canadian economy has depended on its international trading partners in a variety of ways. First, the Canadian economy has relied on inflows of labour, capital goods and financing. Second, exogenous events determined the terms on which its resources could be traded for the imports that it required. These events included shifts in protectionist policies, growing industrialization and urbanization in foreign markets that led to rising demand for raw materials that were available in Canada, and other demand shifts (brought about by the two world wars) that increased the demand for Canadian staple exports.

While shifting international demand for resource products and technological improvements are at the heart of the changing pattern of resource development since 1867, government trade policies have also shaped the growth of the resource economy in various ways.

Shifts in protectionist policies in the mid-18th century led to a growing cross-Atlantic trade in grainstuffs with the United Kingdom, as Europe imported food and cotton and exported clothing and iron products. Imperial tariff preferences for lumber in the early 18th century supported Canadian lumber exports to the United Kingdom.

In addition to general tariff policies (i.e., the protectionist duties that followed the U.S. Civil War, the McKinley tariffs of 1890, the 1921/1922 increases in U.S. tariffs and the U.S. Smoot-Hawley tariffs of 1930), Canadian exports to the United States have been affected by a succession of disputes with the United States over specific resource products. The pulp and paper industry at the turn of the 20th century faced conflicting export taxes on logs imposed by Canadian provinces and import taxes on paper from the United States as Canada sought to have further processing done on its resource exports and the United States sought to protect its processing industries. This conflict was resolved with the removal of the U.S. tariffs on paper in 1913 (Aitken, 1959). Subsequently, a rapid expansion occurred in Canadian paper production. In 1913, Canadian newsprint production was less than 20% that of the United States, but by 1925 had surpassed the latter (Horning, 1940, c19).

Similar conflicts arose over the development of rich nickel–copper deposits in the Sudbury basin (Main, 1955). The McKinley tariff in 1890 admitted nickel ore for free but imposed a tariff on refined nickel. Ontario continuously lobbied for further processing of the nickel ores that were exported from the Sudbury mines, but only after repeated intervention by the Canadian government did International Nickel establish a refinery in Canada in 1915 (Aitken, 1959).

In addition, significant exports of Canadian petroleum followed bilateral Canada–U.S. agreements that brought Canadian policy within a North American energy framework that was acceptable to the United States. The American petroleum industry in the 1950s operated behind protectionist policies that restricted the degree domestic production had to compete with imports of cheaper offshore oil from the Middle East. The United States was not willing to see Canadian oil exported to the United States and benefit from its high petroleum prices while Canada brought in cheaper foreign oil to serve its own markets. It was not until Canada proclaimed a National Oil Policy in 1961 that made Ontario markets off limits for foreign oil that Canadian oil began to flow

to mid-west American markets (Aitken, 1982; Baldwin, 1982). Equally important, transborder flows of natural gas required the resolution of conflicts in the regulatory area (Aitken, 1959; Waverman, 1973). The latter were not completely resolved until the 1989 free trade agreement, which promised American consumers protection from Canadian export limitations that might be discriminatory.

In the post-1980 period, disagreements between the two countries over lumber exports to the United States disrupted trade in this commodity on numerous occasions. The implementation of NAFTA resolved some, but not all, of these problems. In the post-2000 period, as Canadian lumber exports to the United States increased after NAFTA, trade frictions over lumber re-emerged and eventually led to an agreement in 2006 that restricted Canada's softwood lumber exports to levels that the United States found acceptable.

4.3 Sectoral shifts in resource production

The history of Canadian resource development is not one of an unbroken dominance by a single staple. Rather, it is characterized by the development of a succession of resources as international demand shifted, relative prices changed and new technologies emerged to facilitate production of resources that previously could not be profitably developed.

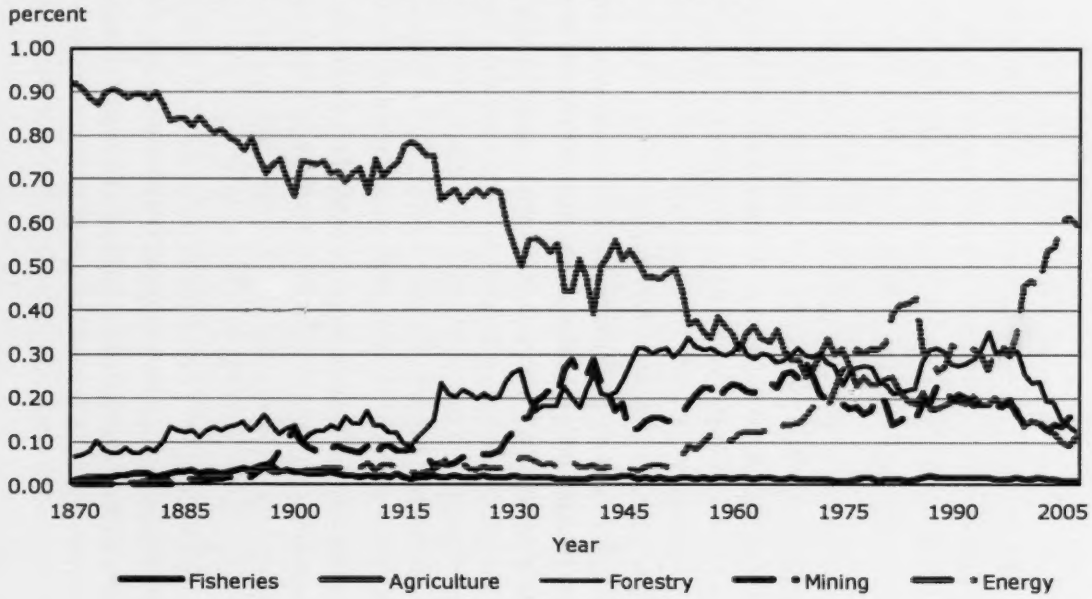
As a result, there have been important compositional changes in the relative importance of different resource sectors from 1870 to 2009 (Chart 1). The resource sector initially focused primarily on agriculture and forest products. By the end of this period, metals and energy emerged as important new resource products.

The deep recession of the early 1870s was accompanied by a short, sharp fall in the relative importance of agricultural production that was quickly reversed. In the late 1890s, the relative importance of agricultural production was about the same as in the 1870s. Subsequently, there was a long but slow relative decline in this sector as a result of the development of the minerals and energy sector, which was only briefly interrupted by the two world wars.

Forestry's share remained relatively constant up to the First World War, fell steeply in the post-war recession and then grew throughout the 1920s as the pulp and newsprint industry expanded rapidly. The same pattern is followed in the 1930s: a decline during the worst of the recession years and then a return to the previous growth path. Forestry's share then expanded after the Second World War to a high in the early 1950s, then declined slowly to the late 1980s when it enjoyed a short growth spurt after NAFTA, only to fall thereafter as the newspaper industry began to decline.

Minerals emerged as a significant sector in the late 1800s and maintained their position until the 1930s, when there was a rapid expansion. The share of minerals declined during the Second World War, when gold production fell, and then rose slowly and steadily back to its mid-1930s peak by 1970. It subsequently declined steadily until the post-2000 period, when the worldwide resource boom occasioned by the rapid growth in the Chinese economy halted this trend.

Chart 1
Share of production of resource products, 1870 to 2007



Note: Production of major resource commodities important for trade. Series back-cast based on modern Input-Output levels and conventions.
Source: Statistics Canada, authors' calculations.

Petroleum products emerged early in the 20th century, but did not begin to grow rapidly until after the Second World War and the discovery of oil at Leduc, Alberta. The sector's share grew rapidly during the energy crises of the 1970s and peaked in 1985, but subsequently declined as energy prices fell, not to return to this level until 2000. With the significant investments in the oil sands, this sector expanded rapidly thereafter, in turn causing the shares of other sectors to decline.

5 Balance of payments

5.1 Exports

Changes in the production of resources are mirrored in the export balances (Chart 2) since much of this production was geared for export markets.[7]

From 1870 to the First World War, agricultural and animal products accounted for over 60% of the total value of exports. Thereafter, its share declined from this peak to 36% in 1939, 22% in 1960, and 10% in 2010.

Forestry accounted for the second largest share of exports in the pre-1900 period—over 30% in the 1880s. Much of this consisted of lumber, which gradually declined in relative importance. By the First World War, the share of forestry had fallen to around 15%. The rapid growth in pulp and paper restored the importance of forestry exports during the interwar years, reaching over 26% in

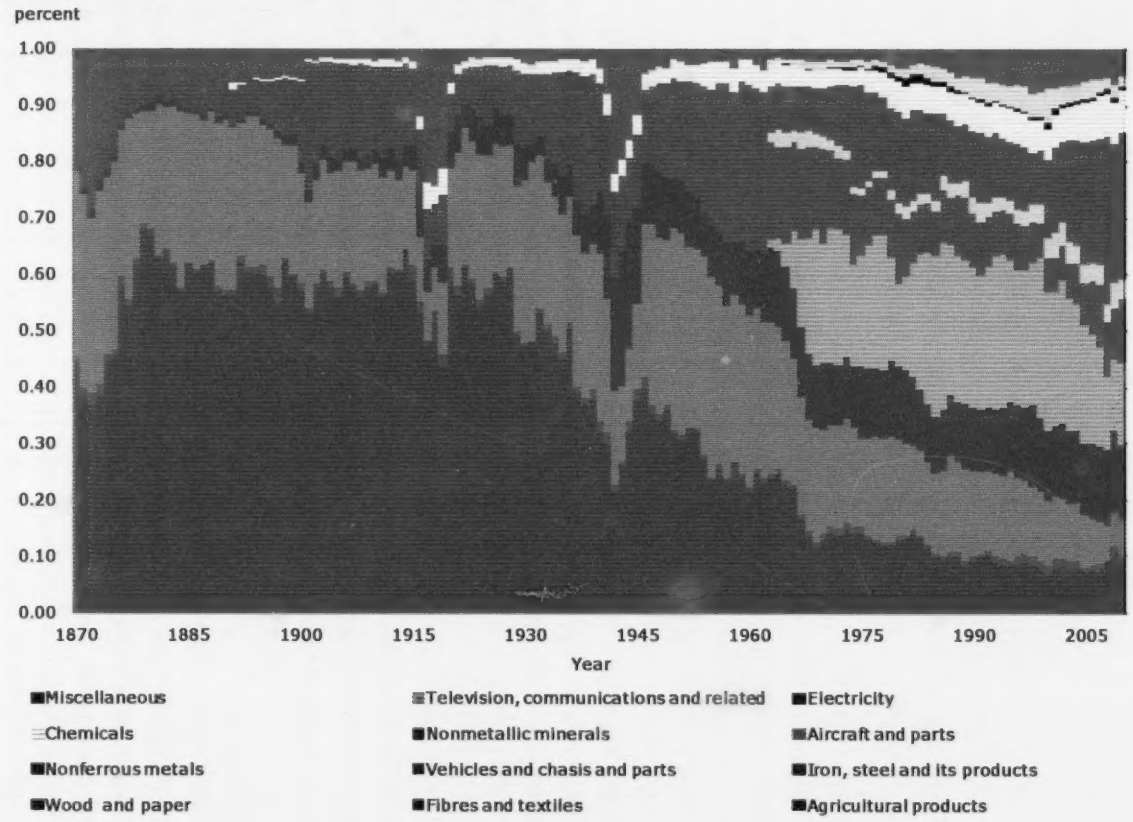
7. See Appendix, section 10.2.

the late 1930s. This sector continued to expand in the period after the Second World War, reaching 35% of exports in 1950 to surpass agriculture in importance. It declined thereafter to 17% in 1980 and 6% by 2010.

The share of non-ferrous metals exports expanded rapidly after 1895 reaching 13% in 1913, just before the First World War. During the interwar years, the share of non-ferrous metals continued to expand reaching 20% just before the Second World War. With increases in real volumes of production after the Second World War, its share increased slightly until the early 1960s and then declined steadily to less than 11% of total exports by 2010.

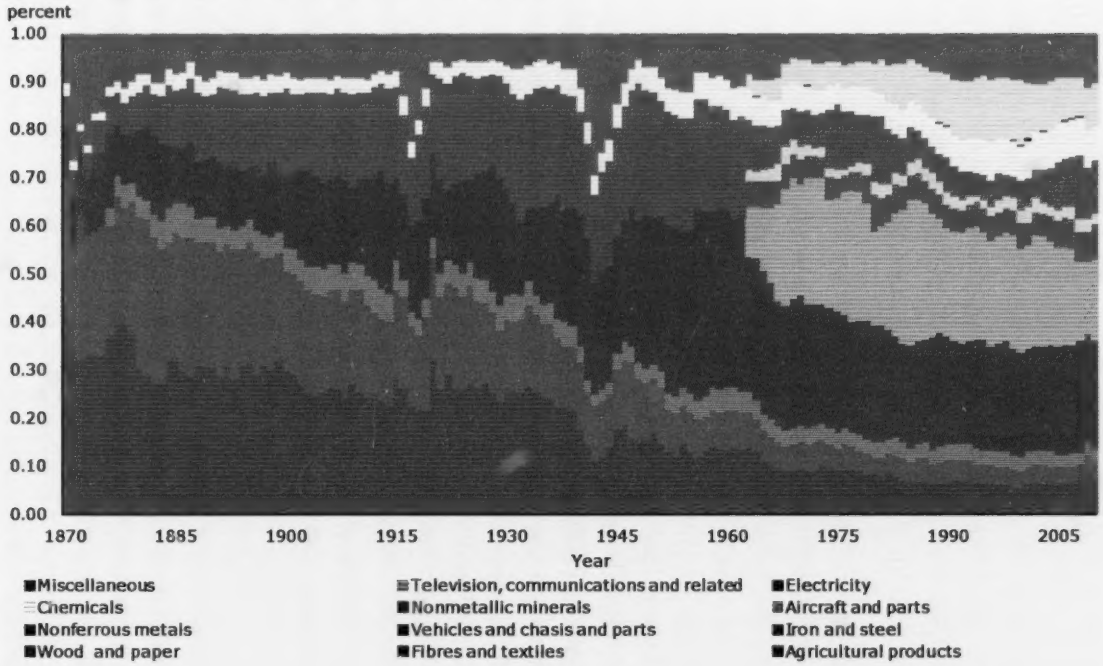
Exports of non-metallic products, primarily oil and natural gas remained under 10% of total exports before 1970, but expanded thereafter (surpassing the importance of non-ferrous metals) to reach 16% by 1980 after the dramatic increase in world oil prices that occurred in the 1970s. The long decline in energy prices until the late 1990s is accompanied by a gradual decrease in the share of non-metallic exports to about 10% by 1999. Thereafter, it began to increase dramatically until it reached 26% by 2010, surpassing each of agriculture, forestry and non-ferrous metals. Partly founded on petroleum, chemical exports accounted for another 8% of exports by 2010.

Chart 2
Share of exports in Canada, 1870 to 2010



Source: Statistics Canada, authors calculations based on Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 3
Share of imports in Canada, 1870 to 2010



Source: Statistics Canada, authors' calculations based on Taylor and Mitchell, Dominion Bureau of Statistics.

Steel was a core component of the manufacturing sector in the United States, but much less so in Canada over most of the period. Before the First World War, Canadian exports of iron and steel products accounted for less than 5% of total exports, though they briefly expanded to around 8% during the First World War I and then fell to about 6% before the Second World War. There is a dramatic expansion to just over 23% at the peak of the Second World War. Thereafter, iron and steel exports continued, but at only a slightly higher level than before the war. They accounted for 9% of exports in 1950, 11% in 1960 and remained close to these levels in the 1970s, 1980s and early 1990s. Through the latter half of the 1990s and after 2000, the share of iron and steel in exports rose to around 13%.

The rapid declines in the share of natural resources that occurred after 1960 came as a result of changes in trade patterns brought about by the 1965 Canada–U.S. Automotive Products Agreement (the Auto Pact), which ushered in a dramatic change in Canada's pattern of trade by helping to rationalize North American auto production. Subsequently, cross-border exports and imports of autos and auto parts increased dramatically. In the early 1970s, exports of autos and parts accounted for 24% of total exports, reaching a high of 30% in 1986. Subsequently, import competition and changing North American production patterns reduced the export share of automotive products to 15% in 2010.

In summary, natural resources have played an important role in Canadian export balances since Confederation. Agricultural, animal products and forestry accounted for over 90% of exports in the mid-1880s. While the importance of natural resources has fallen over time, it remained dominant until 1960, when agriculture, forestry, non-ferrous metals and non-metallic minerals still accounted for over 80% of all exports. Only after the Auto Pact and NAFTA—with the growth in exports of iron and steel, autos and auto parts and aircraft—did the resource share fall to its

lowest point on record, 36% in 1999. The resource boom during the 2000s reversed this long decline, raising the share of resources in exports to 53% by 2010.

5.2 Imports

The composition of imports differs from exports in both the relative importance of the different categories and the commodities that constitute the majority of each category. Although Canada's imports were primarily raw materials in the period immediately following Confederation (Chart 3), agricultural imports consisted of considerable quantities of sugar, tea, coffee, cocoa and spices, in addition to grains and hides—different commodities than those being exported.

Similarly, raw textiles (cotton, wool and silk) were imported for Canada's textile manufacturers. In the 1870s, over 60% of imports consisted of agricultural products and fibres. Imports of wood and paper products represented a small share of imports in the 1870s and continued to do so until 2010.

From the 1870s to 1900, agricultural products and textiles maintained their primacy. But by 1900, the import share of these commodities dropped below 50%, primarily due to a reduction in imports of textiles and fabrics. Agricultural products declined from a share of imports as high as 41% in 1870 to a share around 30% in the 1890s. The First World War had little impact on the import shares of agricultural products or textile products, in stark contrast to the changes in export shares.

Following the First World War, the shares of agricultural products and textiles in total imports continued to decline. The disruptions caused by the Second World War, the Korean War, the oil shocks and trade agreements did little to change the pattern of gradual decline. By 2010, textile product imports made up a similar share of imports as wood and paper products. The share of agricultural products in imports fared similarly, declining from a high of 41% immediately after Confederation to 8% in 2010.

While the share of agricultural products and fibres gradually declined, other raw materials were increasing. The share of non-ferrous metals increased at a fairly constant pace from 1870 to the 1960s. The war years saw temporary increases to meet wartime demand. Prior to the First World War, non-ferrous metal imports consisted of copper, lead and zinc. The expansion after the Second World War was associated with increasing imports of iron ore, nickel and copper ore for smelting, platinum, and bauxite and alumina that fed Canada's export aluminum industries. After the 1960s, the import share of non-ferrous metals averaged around 5%, but was quite volatile.

Energy imports have been important since the late 1800s. Canada did not possess the same large, economic coal deposits found in the United States, and relied on imports. As the manufacturing industry mechanized and the iron and steel industry expanded, energy imports increased. Non-metallic metal imports (consisting primarily of coal and oil) accounted for 11% of imports in 1890, 12% in 1913, 18% in 1939 and 19% in 1950, just as oil in western Canada began large-scale development. The presence of a new domestic supply of oil, combined with policy that ensured Canadian products had Canadian markets to support early development, led to substitution of international sources for domestic sources. Changing technologies for home heating, such as a switch to natural gas in many areas, further reduced demand for imported coal. As a result, the share of non-metallic minerals in imports fell to only 11% in 2010.

Imports of iron, steel and their products also contributed to the development of the domestic economy, though they were relatively small at the beginning—typically 16% or lower from 1870 to 1900. These imports initially comprised products that were either difficult to manufacture in Canada at the time or finished products for investment or consumption. For example, in the 1870s, roughly half of the imported iron, steel and their products was in the form of billets and

blooms, rolling mill products for which Canada had limited production capacity; the other half was more highly manufactured products like transportation equipment. These imports were important inputs for railroad construction and the adaptation and use of global technologies for Canadian industry. In particular, farm implements and mining equipment would have been imported, as would much of the machinery and equipment used in forestry.

The imports of machinery and equipment and steel for infrastructure facilitated the transfer of technology to Canada. This transfer continued even as the federal government sought to create a national market and support manufacturing growth behind tariff walls. As the share of raw material imports decreased slowly over time, the import share of iron and steel and their products increased. The 1960s saw a large increase in the share of automobiles—from 10% in 1963 to 26% in 1971. The increase in the share of motor vehicle imports through the 1960s brought the share of iron, steel and their products to its highest point, 52%, in the late 1960s and early 1970s. After the early 1970s, the share of motor vehicles and parts gradually declined to 17% in 2010. The overall share of iron, steel and their products similarly declined through time, reaching 39% in 2010.

5.3 Net trade balances

Changes in the net balance of each of the product categories illustrates the nature of Canada's trade specialization. Commodity groupings that have a positive balance earn foreign exchange that pays for those with a negative net balance or for past debt accumulation from foreign sources.

To take into account changes over time in the volume of trade that arise from inflation, trade balances are presented relative to nominal GDP. The balances for each of the commodity groupings and for the merchandise trade balance relative to GDP are plotted in Chart 4.

Canada has generally relied on resource or resource products to pay for investment and consumer goods from Confederation to the present. The balances for agriculture, wood and paper products, non-ferrous metals and, more recently, non-metallic minerals have been positive; the net balances for fibres and textiles, iron, steel and miscellaneous products (which include television, communications and related products, electricity and consumer products) have been negative.

In the period immediately after Confederation, wood and paper products and agricultural products were the primary sources of positive trade balances for Canada. They were offset by negative trade balances in other categories: fibres and textile products that fed Canada's fledgling textile industries; iron, steel and their products for activities like railroad construction or machinery and equipment investment; non-metallic minerals, predominantly coal; and miscellaneous products predominantly consisting of consumer products.

Railroad infrastructure and advances in mining and smelting technology led to expanded net positive exports of non-ferrous metals products. After the early 1900s, non-ferrous metals contributed positively to the net trade balance. The expansion and development of the non-ferrous metals industries from 1900 to 1913 was the first in a long line of shifts in the composition of the net trade balance, as Canada broadened the range of products produced from its resource base.

The net share of agricultural products and forestry products continued to hold primacy, even after the expansion of the non-ferrous metals industries. And, although the years during the two world wars saw dramatic shifts in trade patterns, the peacetime composition of the trade balances reverted to its pre-war position quickly after combat ceased. The net share of agricultural products in GDP peaked at 14% in 1918, then fell somewhat after the First World War, but was

still 9% in 1926. From that point forward, the importance of agricultural products in the net export balance declined.

The size of the net positive balance of wood and paper products declined between 1870 and the First World War. The decline between the late 1890s and 1912 likely reflects a diversion of Canadian forest products from export markets to domestic uses such as railroad ties and construction material. Thereafter, the emergence of pulp and paper production and reduced domestic demand increased the net positive share of wood and pulp products to between 2.5% and 4.5% of GDP during peacetime. For roughly 80 years, wood and pulp products added significantly to the net export balance. After the late 1990s, however, the net trade balance on wood and paper products fell to 1% of GDP by 2010.

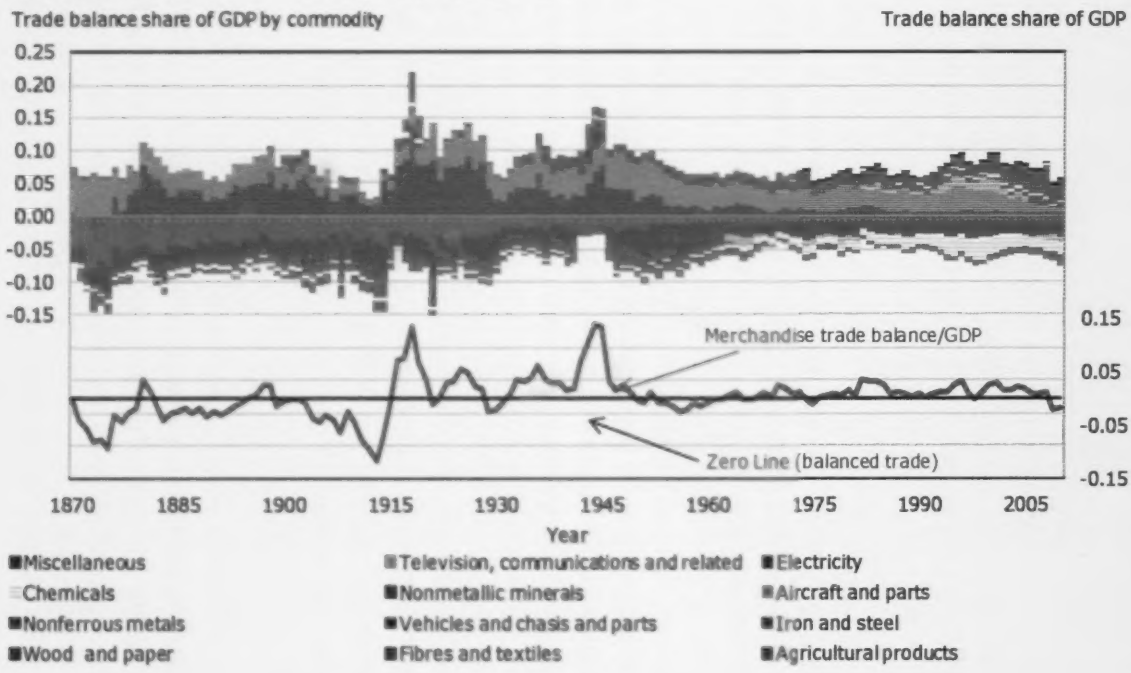
Two developments in the 1960s offset the reductions in the agricultural and wood and paper product balances. The first was the ongoing development of oil and gas in Alberta and the second was the signing of the Auto Pact. Of the two, oil and gas development was more important for net export balances.

The oil and gas sector generates the net positive balance for non-metallic minerals, which went from a negative net balance prior to 1967 to a positive balance thereafter. As a share of GDP, the net trade balance on non-metallic minerals declined from less than -1% in 1870 to a low point of -4% in 1921. The balance steadily improved after 1921, and became positive in 1967. After 1967, the net balance continued to climb, reaching 3.2% of GDP in 2010.

The Auto Pact reoriented export flows toward manufactured products and strengthened Canada's manufacturing base. However, Canada continued to import large quantities of vehicles; only in the 1980s did the trade balance on motor vehicles and parts become positive. During the 1960s and 1970s, the net balance on motor vehicles and parts tended to be negative, often reaching levels of -1% of GDP. The 1980s and 1990s saw the net balance on motor vehicles and parts improve, eventually reaching 1.8% in 1999, approximately the same net balance share of GDP as non-metallic minerals. After 1999, however, the net balance on non-metallic minerals continued to increase but the net balance on motor vehicles and parts began declining, and eventually reached -1% of GDP in 2010.

For product classifications comprised mostly of imports with a negative trade balance, the composition through time has consistently moved away from intermediate products and toward final goods. In the early years after Confederation, fibres and textiles were the major import group. Their net balance between 1870 and 1890 was typically around -5% of GDP. The textiles being imported during this period were, in large part, intermediate products such as cotton and wool to feed Canada's developing textile mills. As industry evolved and large amounts of textile production moved outside of Canada, the share of the textile and fibre trade balance declined as the relative demand for imports in this category waned.

Chart 4
Trade balances in Canada, 1870 to 2010



Source: Statistics Canada, authors' calculations based on Taylor and Mitchell, Dominion Bureau of Statistics.

The share of the net import balance for iron, steel and their products in GDP has fluctuated. In the period leading up to the Second World War, it exhibits little trend; however, after the war, there is a period of heightened imports when the net balance reaches -5.3% of GDP. After 1956, a long upward trend begins when the negative share of iron, steel and their products is diminished. This was partly the result of rising export values for motor vehicles and parts, since excluding motor vehicles and parts produces a share of net iron and steel products quite near the long-run average of -2.4% after 1963.

Iron and steel and their products is the commodity classification under which advanced manufacturing technology was imported into Canada, since the technology is typically embedded in the machinery and equipment purchased on international markets. In the latter half of the 20th century, however, a computer revolution changed the cost of acquiring information and occurred in a class of products comprised predominantly of non-iron and non-steel products—fibre optic cables, computers and electronic switches. The historic aggregations would have included these types of products in miscellaneous imports and exports. Prior to the 1960s, they would not have constituted a very large value. After the 1960s, and particularly through the 1990s, these types of products became increasingly important for the investment decisions of Canadian households and firms.

The value of electronic and computer imports can be separated from the miscellaneous category after 1963, after which modern data sources are available in electronic format. The 'high-tech' balance is measured here by aggregating all television, communications and related equipment, including office machines like computers and photocopiers. The net balance as a share of GDP declines from less than -1% in 1963 to a high of -2.7% of GDP in 1999. This was more than the net share of income spent on iron, steel and their products (i.e., traditional machinery and equipment) even excluding the impact of the Auto Pact. The level in 1999 was temporary and, after 2001, the net balance returned to around -1.5% of GDP.

6 Price history

The prices of resource exports have trended upward faster than Canadian imports over most of the post-Confederation period, though the identity of the resource sector that led this upward movement changed over time

Comparisons of the course of individual export prices to the overall average of all exports reveal which resource staple served to drive the terms of trade in different periods.

6.1 1869 to 1914

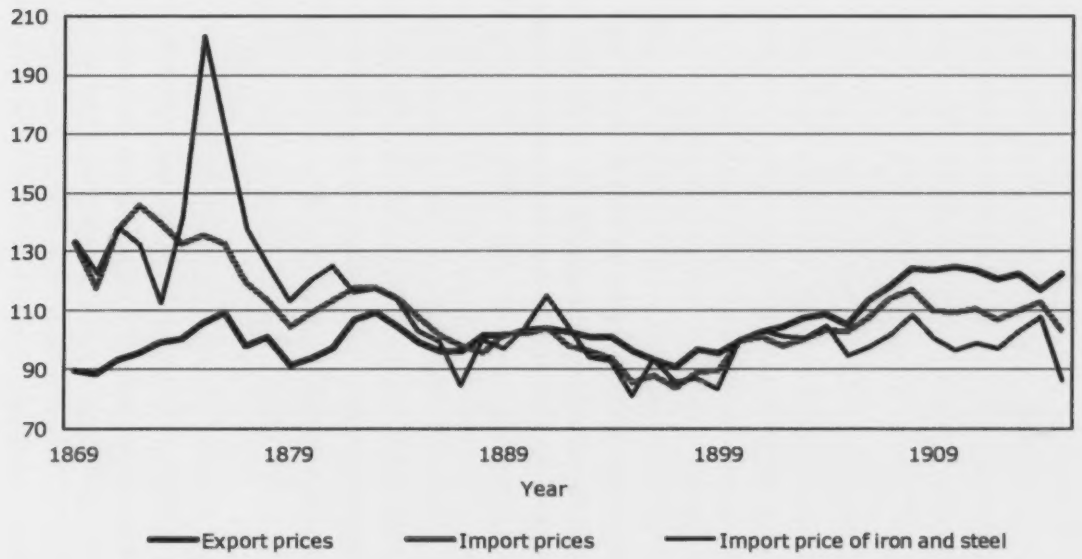
The period after the deep world recession of 1873 was characterized by falling prices across many commodities. Price declines were accompanied by the development of the fertile agricultural lands of the western United States, leading to dramatic increases in world agricultural production. At the same time, the industrial revolution and associated productivity improvements produced iron and manufacturing products at increasingly lower prices.

During the period of declining prices after 1873, the prices of grain exports (one of Canada's main agricultural exports) fell, but by less than the prices of iron and steel (one of Canada's major inputs). The reverse occurred in the period of rising prices. From 1896-1897 to 1911-1913, grain prices rose more rapidly than the prices of iron and steel.[qq] As a result, by 1913, the prices of grains and flour had risen almost 50% relative to the prices of iron and steel.

Dramatic changes in transportation technology affected Canada's terms of trade during the late 19th century. The transition from wood to steel and wind to coal for propulsion purposes in ocean transport decreased ocean freight rates from 1872 to 1911 by 63%.[rr] Rapid productivity growth in the iron and steel industry led to relatively large decreases in the relative prices of iron products imported into Canada.[ss]

Chart 5
Import and export prices, 1869 to 1914

Index 1900 = 100



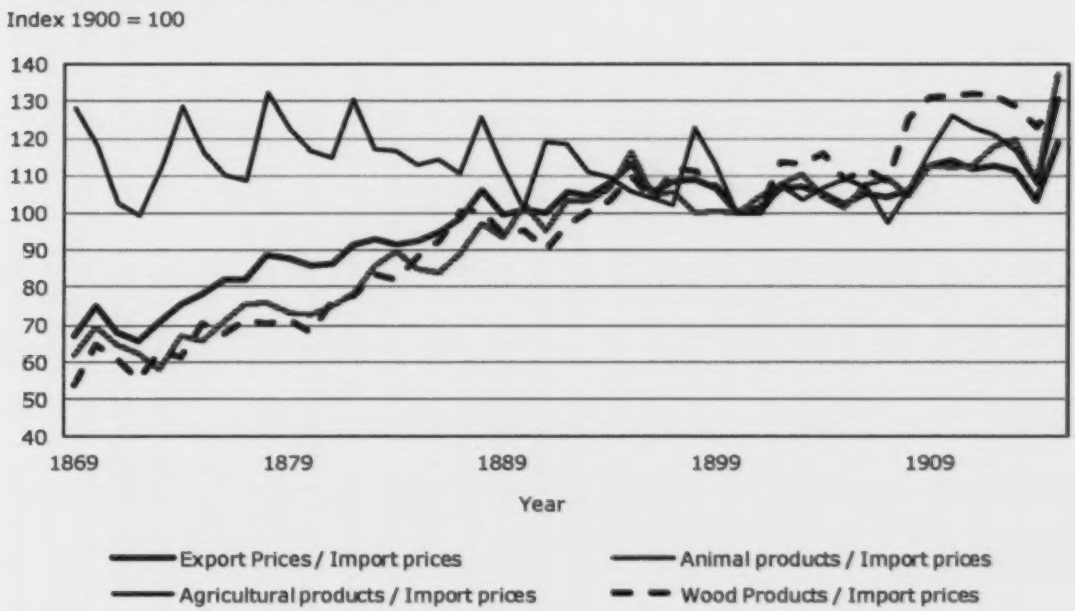
Source: Taylor and Mitchell.

In addition to grains, Canada also exported animal products such as meat and cheese. The other major resource export was sawmill products made from raw logs. The prices of these animal and wood products increased relative to grain exports. The export prices of animal and meat products went up by 26% and dairy products by 17% from 1872 to 1911, as Canadian exports benefited from rising standards of living in the United Kingdom and the high income elasticity of these food products.[tt]

While Canada imported much of its iron and steel requirements, a large portion of Canadian imports consisted of agricultural products, notably wool and cotton. At the beginning of the period, agricultural products made up 27% of imports, textiles 26.5% and iron and steel only 12.8%.[uu] By the period from 1906 to 1915, the share of agricultural products had fallen to 16.6% and textiles to 17.4%, but iron and steel had risen to 17.4%.[vv] Despite the heterogeneous nature of overall import trade, the overall decline in Canadian import prices over the period (Chart 5) followed the general decline in iron and steel prices.

In contrast, export prices as a whole increased from 1869 to 1877 and then fluctuated around the same level to 1900. Together, declining import prices and increasing export prices led to a terms of trade increase (Chart 4).

Chart 6
Individual export prices, 1869 to 1914



Source: Taylor and Mitchell.

The terms of trade rose over this period because Canadian agricultural exports were concentrated in commodities that did not follow the overall downward trend in agricultural prices. During the period, the prices of both agricultural exports and imports generally followed the same downward trend. In contrast, the price of Canadian exports of animal products actually increased. So too did wood products, which consisted heavily of sawn lumber (Chart 5). On the import side, fibres and textiles, which consisted largely of raw cotton and wool, followed the general downward trend of agricultural products being exported. So did the price of iron and steel products being imported. Together, declining import prices and increasing export prices led to a terms of trade increase (Chart 6).

During the period of rapid growth of the wheat economy in the first two decades of the 20th century, both export and import prices increased, but the former increased faster than the latter. As a result, the terms of trade continued to increase (Chart 6). From 1896 to 1920, wheat prices moved sharply upward and, although iron prices rose as well, the latter outpaced the former. But again, animal and wood (lumber) price increases led to a relatively larger overall export price increase. Price increases for lumber resulted from building booms associated with urbanization in the United States. From 1880 to 1920, the percentage of the U.S. population living in urban areas increased from 28% to 51% (Kim and Margo, 2003).

6.2 1914 to 1939

The First World War drove up demand, which resulted in dramatic price increases for both imports and exports; but the latter outpaced the former (Chart 7). Some of this was related to wartime demand for raw materials such as non-ferrous metals and foodstuffs like wheat. In 1917, wheat prices were 248% above the levels of 1913, lead was 239% higher and copper was 178% higher.[ww]

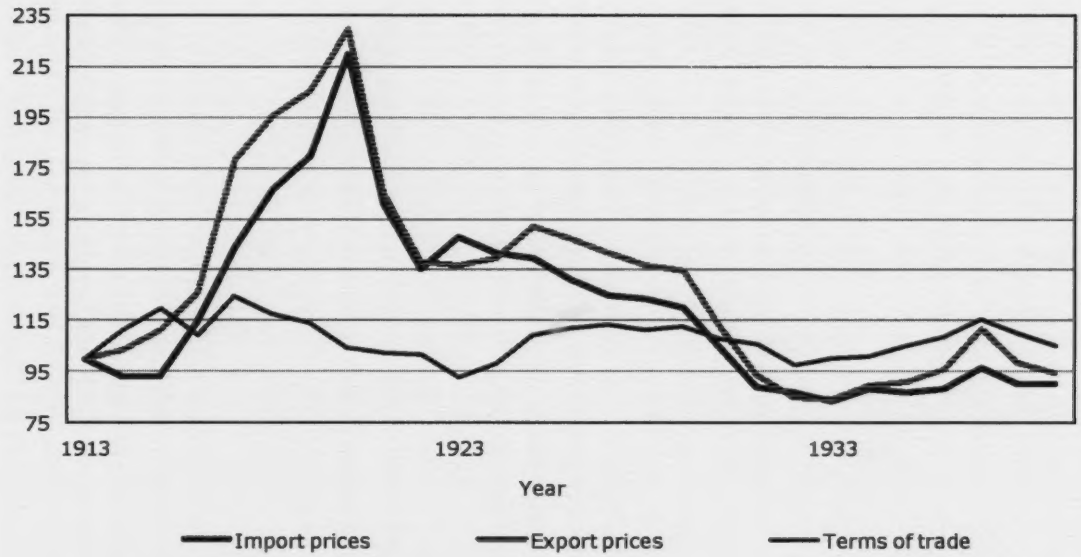
But even the pulp and paper industry—the staple resource export with one of the most rapid growth rates during this period—saw rapid price rises that exceeded those of exports in general.

The price of pulp exports was $17 per ton in 1908, $21 in 1914, $31 in 1916, $67 in 1918 and $93 in 1920—an increase of over 500% in a little more than 12 years.[xx]

During the early part of the war, export prices rose much faster than import prices, increasing the terms of trade. But by the end of the war, import prices had caught up (Chart 7). This suggests a pattern whereby inelasticity of supply benefited resource exports early in rapid expansion periods—a pattern that was to follow in the later post-Second World War period.

Chart 7
Import and export prices, 1913 to 1939

Index 1913 = 100



Source: Historical Statistics of Canada.

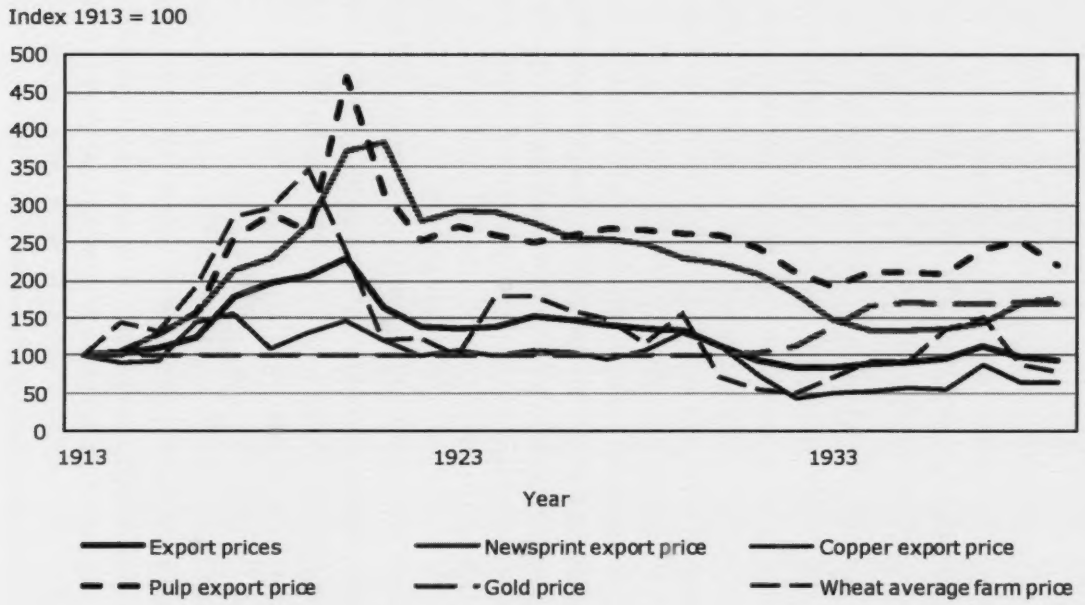
The early 1920s saw a dramatic decline in prices after the First World War, the result of a short, sharp recession. Wheat fell the most (71%) from 1919 to 1923 (Chart 8).[yy] Copper returned to its 1913 levels first, followed by wheat; pulp and newsprint prices remained at higher levels throughout the decade. During this period, export prices fell more quickly than import prices. While the rapid growth of raw material exports was associated with increasing terms of trade, the opposite occurred during the recession that followed.

Wheat prices rebounded from their low point in 1923 with a subsequent expansion of demand, primarily because European demand eventually recovered and eastern European supply remained diminished during this period. While non-ferrous metal, pulp and newsprint prices declined, they remained above their 1913 levels throughout most of the decade. The terms of trade fell 23% from 1921 to 1923, but rebounded by 1927.[zz]

The 1930s were accompanied by a dramatic fall in both the volume of trade and prices. The extent of the decline in prices during the early 1930s had not been seen since the 1873 recession. The declines started in grain prices and eventually spread to non-agricultural raw materials such as non-ferrous metals and pulp and paper prices (Chart 8). As a result, the terms of trade fell 7% from 1929 to 1935.[aaa] As in the early 1920s period, recession was associated with a decrease in the Canadian terms of trade.

Export prices fell by 50% from July 1929 to January 1931.[bbb] Wheat prices fell by 67% from 1929 to 1932. They rose in the second half of the 1930s, returning to 1929 levels by 1937.[ccc] Many import prices also collapsed over the same time period, but not by as much as exports. As a result, the terms of trade fell 7% from 1929 to 1935.[ddd]

Chart 8
Individual export prices, 1913 to 1939



Source: Historical Statistics of Canada.

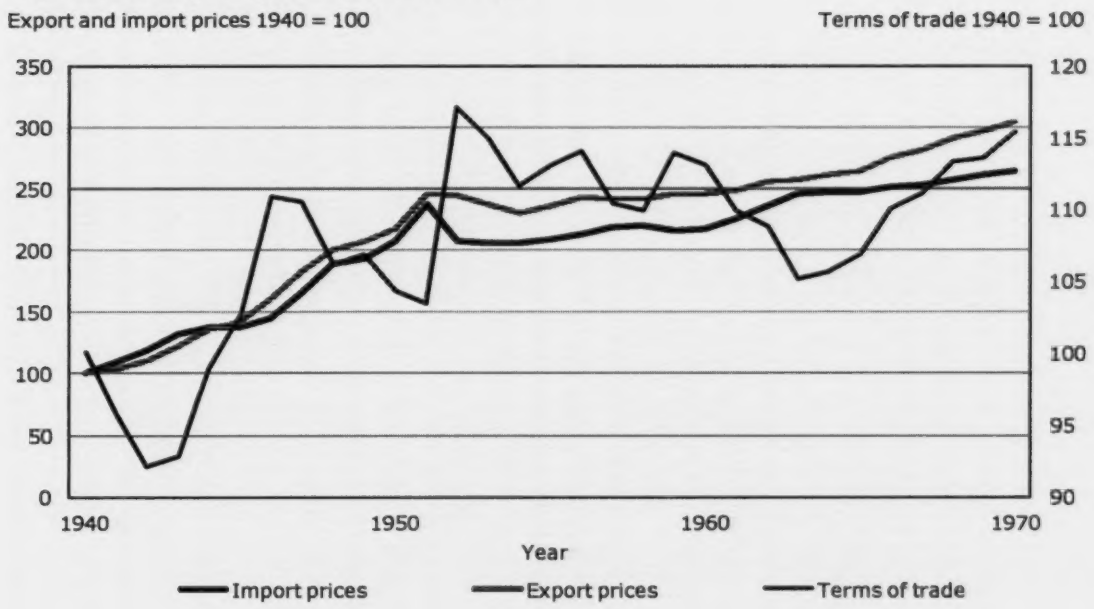
A bright spot for resource prices in the 1930s was gold. With the U.S. monetary revaluation, gold increased from US$20 an ounce to US$35 in 1935.

In summary, some of the extensive gains seen during the First World War in the terms of trade dissipated over the interwar period. Short, sharp declines occurred at the beginning of each of the two recessions during this period. Just as the expansionary period of the First World War saw dramatic increases in export prices, the two recessions saw some of the increases reversed for a short period. Expansions late in each of the two decades were once again associated with increases in the terms of trade. Expansion of the world economy during this time was associated with gains for Canada, and recessions of the world economy with losses.

6.3 1940 to 1970

The terms of trade did not fluctuate as violently during the Second World War as they did during the First World War (Chart 9). A decline occurred during the early years of the war when the United States was not yet a full participant. However, the terms of trade rose in the last few years of the Second World War.

Chart 9
Import and export prices, 1940 to 1970



Source: Historical Statistics of Canada.

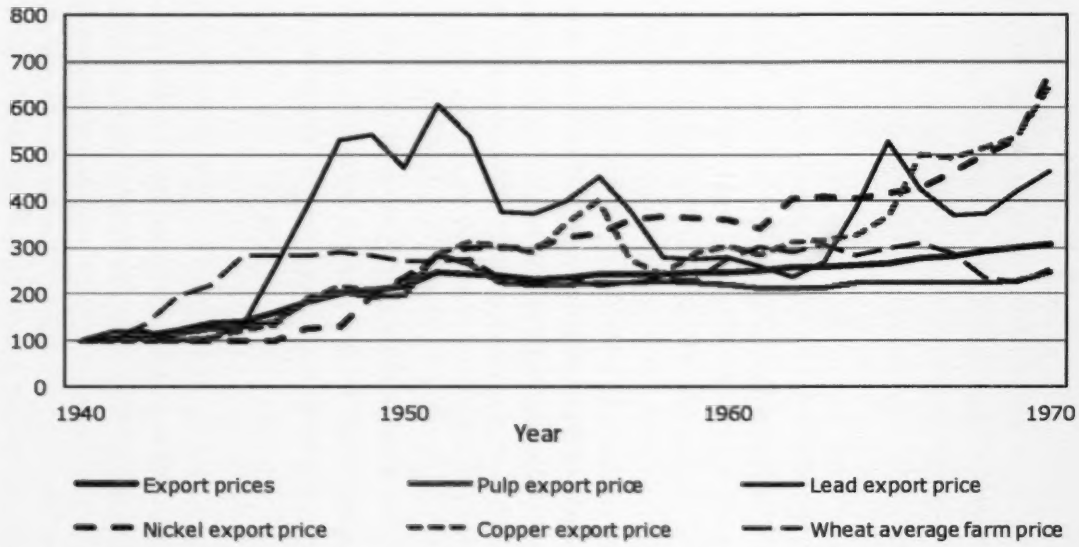
The post-war period continued these upward movements because of buoyant export prices for resources (Chart 10).

Rising wheat prices after the Second World War accompanied rapidly expanding harvests. But prices of non-ferrous metals—lead and copper—generally did better than exports as U.S. industrial capacity expanded rapidly and the North Atlantic economy recovered from wartime devastation.

Unlike the interwar period, pulp prices lagged slightly behind the others. Nevertheless, expansion helped boost the overall terms of trade by about 20% by the end of the period.

Chart 10
Individual export prices, 1939 to 1970

Index 1940 = 100



Source: Historical Statistics of Canada.

6.4 1971 to 2010

The structure of Canada's trade after 1970 was influenced by two major developments in the Canadian economy. The first was a rise in energy prices that were accompanied by a rapid growth in exports. In 1971, energy products made up 7.1% of exports. This increased to a high of 25.7% in 2008 before falling back to 21.6% in 2009. The rising importance of energy products, combined with large price swings in energy commodities, made energy products and prices a dominant feature of Canada's terms of trade movements during the last 40 years.

The second major development was the rise of automobile manufacturing. The 1965 Auto Pact required that automobile manufacturers in Canada produce one American vehicle for every U.S. nameplate vehicle purchased in Canada. The result was a rapid expansion of automotive manufacturing in Ontario and, to a lesser extent Quebec, which for the first time produced a sizeable share of exports coming from durable manufacturing. From 1963 to 1969, the share of vehicles, parts, chassis and vehicle engines in exports rose from 1% to 24%. The integrated nature of automobile assembly processes also led to growth in the share of vehicle and parts imports into Canada. From 1963 to 1969, the share of vehicles and parts in imports increased from 10% to 25%. While the trade shares rose appreciably, the prices of automotive exports and imports tended to move similarly so that, although the Auto Pact affected trade values, it had little direct impact on the terms of trade.

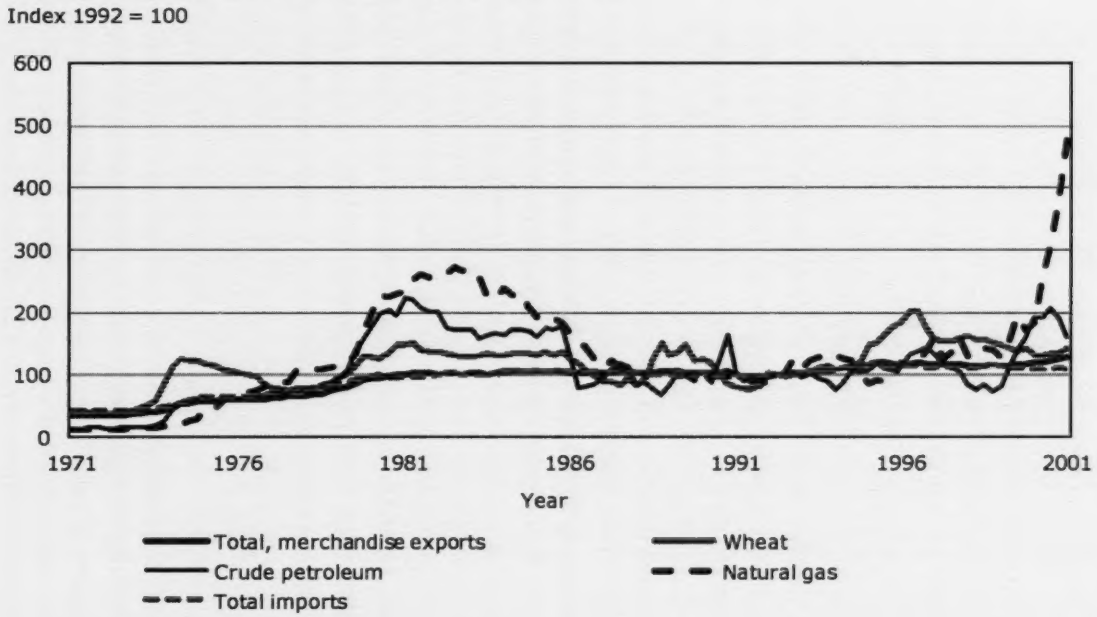
The rise in the importance of energy products was the result of new discoveries of supplies in Canada and of rising prices brought about by the oil shocks in 1973 and 1979. Both price and quantities increased but, of the two, the rise in prices was larger. From 1971 to 1977, the price of crude petroleum exports rose 100%. By 1981, it increased another 100%.

While rising prices for energy products, particularly oil, were synonymous with the 1970s, oil was not the only commodity that saw rapid price growth. Wheat prices increased faster than crude petroleum in the early part of the 1970s: while they later regressed, they were still more

than 100% higher in the mid-1980s than they were in 1971 (Chart 11). Forestry products and metals also increased, though less quickly than wheat and energy. The prices of these export staples increased faster than overall export prices and more rapidly than the prices of automobiles and parts, the other major exports during this period.

The 1980s reversed the upward movement in commodity prices. The decade began with the onset of a global collapse in energy prices, which was reflected in Canadian export prices for petroleum (Chart 11). Export prices for energy fell around 50% in 1986, returning to 1977/1978 levels as global oil prices collapsed. Throughout the remainder of the 1980s and for most of the 1990s, crude oil prices fluctuated around levels similar to the mid-1970s.

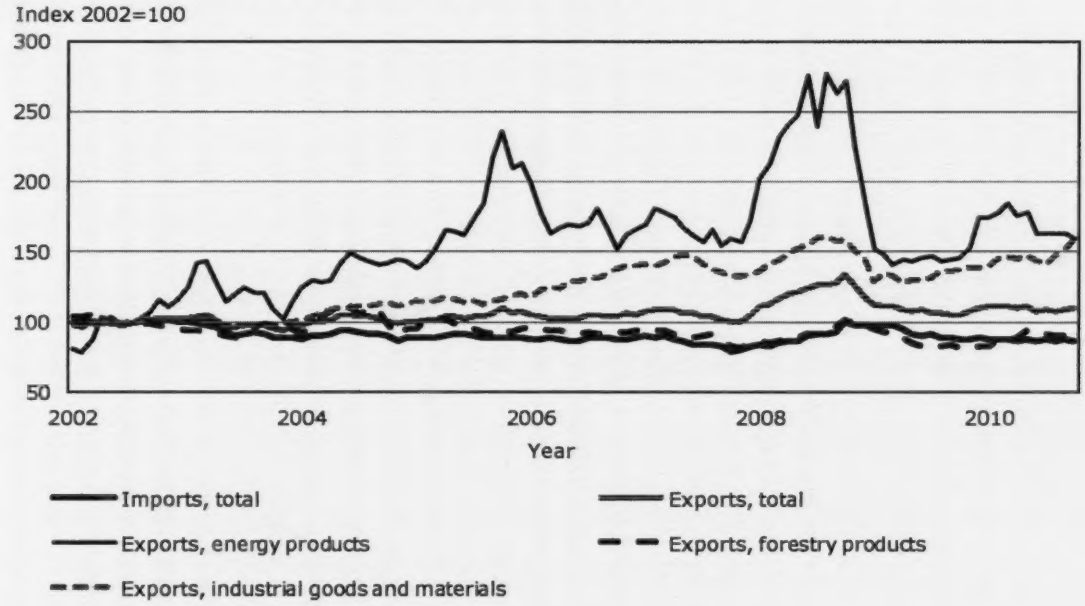
Chart 11
Import and export price indexes, 1971 to 2000



Source: Statistics Canada, Cansim tables 176-0006, 176-0007.

As in earlier periods, oil was not solely responsible for the hiatus in overall resource price increases. Many resource products experienced stagnant or weak price movements through the 1980s and 1990s, including gold, natural gas and wheat. Prices for base metals, lumber and, to a lesser extent, pulp were the resource standouts during the late 1980s and 1990s, but these increases were modest compared with some previous periods. Prices in U.S. markets for lead rose at an annual compound rate of 5.4%; for nickel, 3.4%; for lumber, 5.8%; and for pulp, 1.2%.

Chart 12
Import and Export Price Indexes, 2002 to 2010



Source: Statistics Canada, Cansim table 228-0053.

Export prices for agricultural commodities remained essentially unchanged from 1981 to 1992 and from the mid-1990s to the mid-2000s.

The 1990s were characterized by rising prices for wood products, as softwood exports to the United States grew after the introduction of NAFTA. Overall, commodity export prices began to increase (Chart 11). After 2000, a demand-driven resource boom occurred. A co-ordinated global expansion, combined with the emergence of Chinese demand for natural resources, stimulated demand for most resource products. Oil, grains, metals and lumber prices saw rapid price increases.

The rising demand for resources, particularly energy, increased the prices that Canadian producers received in international transactions (Francis 2007), and lowered import prices through falling global prices for manufactured products and a currency appreciation driven by rising commodity prices (Amano and van Norden, 1992; Ballieu, 2005). The combination of the effect of rising resource prices on exports and the appreciating dollar led to a rapid increase in Canada's terms of trade after 2001 (Chart 12). Energy prices led the way, but material prices (non-ferrous metals) also increased relative to import prices.

7 Trading gains: terms of trade, the gross trade balance, real exchange rate and the net trade balance

The previous sections have tracked the expansion of resource-extractive industries and the periods when Canada benefited from improvements in the terms of trade.

Rising export prices relative to import prices lessened the burden of purchasing consumer goods and machinery and equipment on world markets, and the burden of repaying foreign debt accumulated as infrastructure (such as canals, railways, pipelines and hydroelectric facilities)

was put in place. In the absence of adequate domestic savings to fund the capital investment required, the influx of predominantly British and American capital funded first canals, then railroads and, later, pipelines, and left Canada a substantial external debt that was serviced with Canada's net positive surplus on the trade accounts.

The wealth of detail presented previously emphasizes the depth and breadth of resource development and the importance of natural resource exports for the purchase of investment and consumption goods in world markets. This section integrates the detail of each period to provide a long-term overview, focussing on long-term trends in the macro environment. It stresses that the individual sub-periods, when examined in their totality, show the cumulative effect of trading gains gradually increasing, resulting in Canadian real income growth higher than real output growth in the time since Confederation.

Only by providing an overview of the performance of the Canadian economy over a sequence of decades can shorter-run fluctuations be separated from long-run trends. This is important: fluctuations that reverse themselves can all too easily be characterized as having only short-run effects associated with boom and bust phenomena—gains that are completely dissipated over the long run.

As the previous sections have shown, reversion-to-the-mean in the terms of trade did occur during the cycles that the Canadian economy passed through. Economic expansions are followed by contractions: the former are associated with improvements in the terms of trade, the latter with declines.

But the central question is whether the Canadian economy was better off at the end than at the beginning of the period, after taking into account the relative movements in export and import prices—whether the increases served to ratchet up the economy to ever higher levels of real income over the post-Confederation period.

As demonstrated in Section 3, the impact of changing prices for exports and imports comes from changes in the terms of trade, multiplied by the gross share of trade, and the real exchange rate, multiplied by the trade balance (Equation 1). Each will be examined in turn.

The ultimate point of interest is the impact of changes in the trading gains on the growth in Canadian real GDI. The impact depends not only on changes in relative prices of imports and exports as well as the prices of traded versus non-traded commodities, but also on the importance of trade (net and gross trade balances). The difference between GDI and GDP is used here to encapsulate these four components into one summary statistic. In turn, GNI differs from GDI by including the income flows used to service the capital account—interest and dividends remitted to foreigners to pay for the investments they made in Canada.

By examining the trajectory of the movement in real income, changes in trading gains can be translated into a measure of its impact on Canadian well-being. This measure not only overcomes the disadvantage of having to focus just on trade prices, but also enables us to examine the total impact of all exports and imports. While raw materials made up a large proportion of all exports, processed raw materials like newsprint increased in importance after 1900. By estimating the trajectory of real income, the method employed here takes into account all exports and imports—though, as the previous sections have emphasized, exports of resources make up a substantial percentage of net exports throughout the period.

Two measures of absorption can be used to examine the course of increases in real income—GDI and GNI. Differences between GDP and GDI are occasioned by trading gains. Differences between GDI and GNI come from the flows of international income. Differences between GDP

and GNI encompass both the trading gains associated with trade in goods and services and the international income flows that are so closely tied to Canada's early economic development.

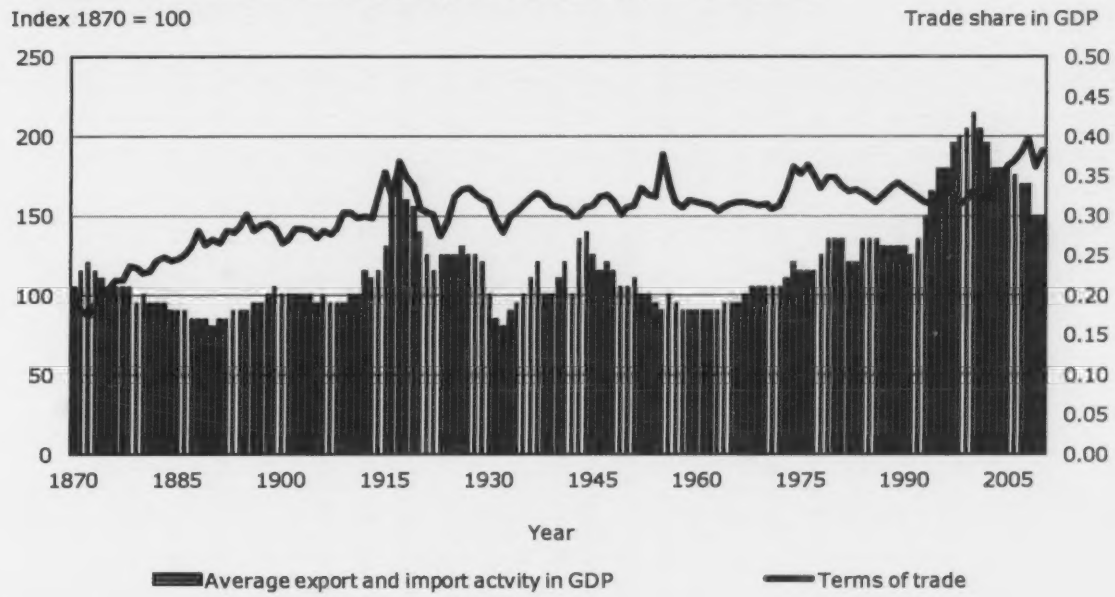
7.1 Terms of trade and the gross trade balance

Canada's terms of trade increased from 1870 to 1890 (Chart 13). While this period immediately after Confederation saw slower GDP growth than the period from 1890 to 1920, when the western wheat economy grew so rapidly, gains in the terms of trade in the early period exceeded those in the latter.[8]

Few gains were made from 1890 until the First World War, when the terms of trade rose again. Subsequently, sharp fluctuations occurred. The declines during the recessions of the early 1920s and 1930s gave way to increases in the latter part of each decade. The net effect was that, in 1939, at the beginning of the Second World War, the terms of trade had increased relative to the period just prior to the First World War. Fluctuations in the terms of trade during the 1920s and 1930s magnified the effect of the recessions associated with movements in real GDP.

After the Second World War, the terms of trade rose in association with the Korean War, then underwent a hiatus until the early 1970s when the first oil shock, associated with the formation of OPEC, dramatically increased the terms of trade again. The long relative decline in oil and other resource prices after 1980 was accompanied by a reversal in the terms of trade until the post-2000 resource boom that saw gains in relative prices for resources generally. Once more, the terms of trade reached new highs.

Chart 13
Terms of trade index and aggregation weight, 1870 to 2010



Source: Statistics Canada, authors' calculations.

8. See Appendix, sections 10.1 and 10.3.

The cumulative gains in the terms of trade since 1870 are substantial. Starting in 1870, gains cumulated to 45% by 1919, 65% by 1939 and 80% by the early 1970s, before gradually falling back. After 2000, the terms of trade rose again; after the 2008/2009 recession, they reached a similar level to that achieved in the 1970s.

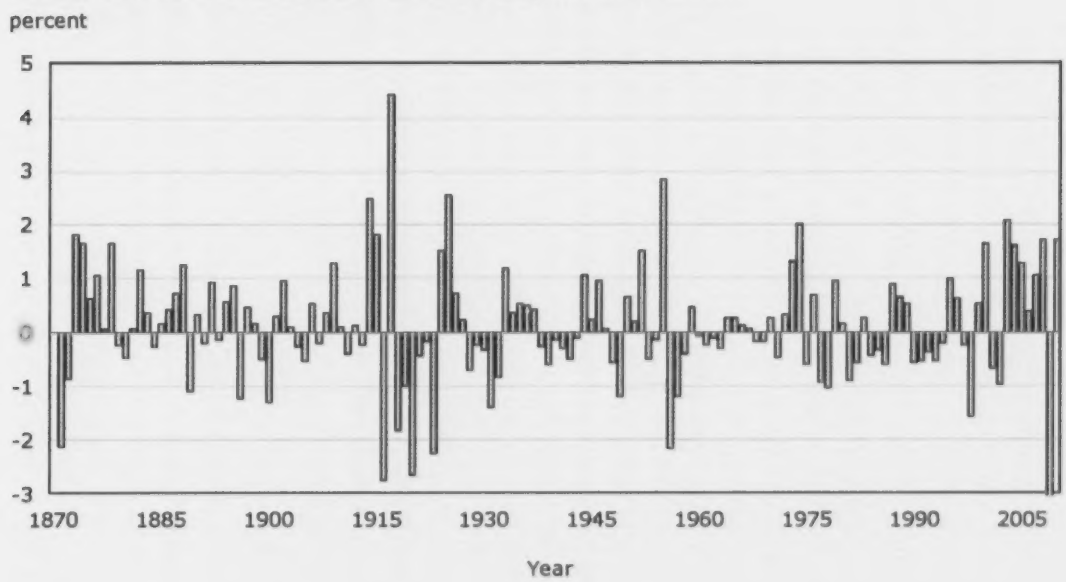
The impact of the rising terms of trade on the size of trading gains is affected by the size of the trade balance—the ratio of imports plus exports to GDP. Canada has seen considerable fluctuations in this balance (Chart 13). As a result, the impact of increases in the terms of trade on the difference between real income and GDP has varied over time (Chart 14).

After initially rising in the 1870s, the average share of trade in GDP declined from 1872 to 1888. During this period, the influence of improvements in the terms of trade was attenuated. Subsequently, the growth in the western frontier was associated with a rise in the trade share that boosted the impact of increases in the terms of trade. After the turn of the 20th century, the average share of trade in GDP once again fell, then advanced around the years of the First World War.

The rapid rise in the average share of trade in GDP, combined with rapid increases in resource prices associated with wartime production, generated the largest gains since Confederation in real income from Canada's terms of trade in the period around the First World War. The gains in 1914, 1915 and 1917 are notable for the size of their positive contributions (Chart 14).

Following the First World War, Canada reached what was then a historic high for the ratio of trade to GDP. While this high international trade exposure had a positive effect on trading gains during the war years as the terms of trade increased, it became a liability in the post-war years: the terms of trade declined sharply when international prices plummeted. In 1918, 1919 and 1920, the terms of trade declined sharply. That, combined with the sensitivity of measures of trading gains to the terms of trade because of the very high share of trade relative to GDP at this time, caused trading gains to decline by historically large magnitudes (Chart 14).

Chart 14
Terms of trade contribution to real GDI, 1870 to 2010



Source: Statistics Canada, authors' calculations.

When the world returned to peacetime production in the 1920s, the average share of trade in GDP declined but remained elevated relative to its pre-war levels. After the economic collapse of 1929/1930, and the higher global tariff levels which greatly reduced trade, the average share of trade in GDP returned to pre-First World War levels. This fall in the share of trade lessened the effect of the terms of trade declines during the onset of the Great Depression.

The share of trade in GDP rose following the initial declines from 1929 to 1931, and it increased from 1934 to 1937 following the *Gold Reserve Act* of 1934, which stimulated gold production in Canada. However, the slowdown in 1937 led to reduced trade activity relative to GDP, and by 1938 the share of trade had retreated to 1934 levels.

Trade share in GDP rose during the Second World War, from 20% in 1938 to 28% in 1944. However, the trade share did not rise as quickly as it did during the First World War; because of wartime prices controls. For similar reasons, the terms of trade did not rise as steeply as during the First World War.

In the period from the end of the Second World War until the 1960s, trade activity as a share of GDP fell. By 1960, the average share of GDP in trade was similar to that of 1933. As a result, fluctuations in the terms of trade around the Korean War, while large, did not lead to as large increases in real income as the fluctuations seen during the First World War.

After 1960, the share of trade in GDP began rising and continued to do so until 2000. This period was characterized by successive rounds of trade liberalization and increasing trade. For Canada, the average trade share in GDP rose from 18% in 1960 to 43% in 2000. The period immediately following the introduction of NAFTA posted particularly impressive increases for the average share of trade in GDP.

The result of these increases after 1960, and particularly during the 1990s, was to raise the average share of trade in GDP to historically high levels for Canada. When the resource boom began after 2000, and virtually all commodity prices began gaining rapidly in relative terms, the terms of trade rose and contributed over a percentage point to real income growth in 2000, 2003 to 2005, 2007, 2008 and 2010 (Chart 14). In turn, the collapse of commodity prices during the 2008–2009 recession reduced the trading gain by -3.1%, the largest decline on record.

7.2 The real exchange rate and the net trade balance

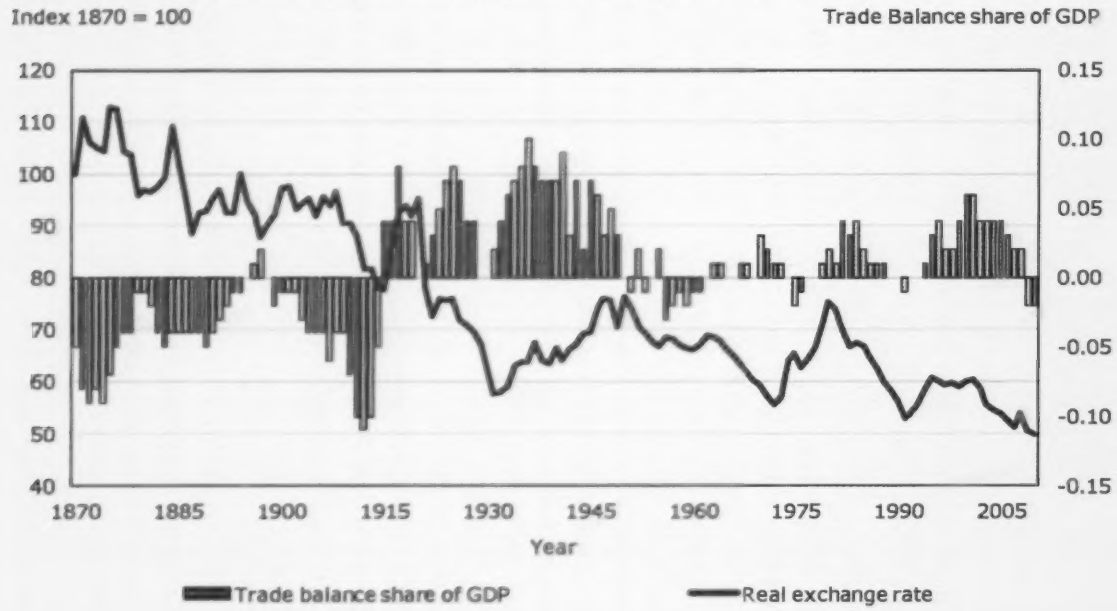
The second component of trading gains is derived from changes in the real exchange rate—changes in traded prices relative to domestic prices. This component captures changes in the purchasing power of the domestic economy that are generated from changes in net export income. Increases in traded prices relative to domestic prices leads to higher domestic income provided the trade balance is positive, and the reverse if it is negative. If the trade balance is positive, higher prices for traded goods provide greater purchasing power in the domestic sector. If the trade balance is negative, higher prices for traded goods mean more domestic income needs to be devoted to traded goods and less is available for domestic purchases.

It is noteworthy that the contributions of changes in the real exchange rate index to changes in the difference between real income and real output growth will be smaller than the contributions of the terms of trade index because the weights are the net trade balance not the gross trade flows.

The real exchange rate fell from 1870 to 1930 (Chart 15), but imports exceeded exports during the period (Chart 15). Contributions to the difference between real income and real GDP were generally small or offsetting (Chart 16). This was also the case in subsequent periods—except during the two world wars—when the large net positive balances contributed to larger positive

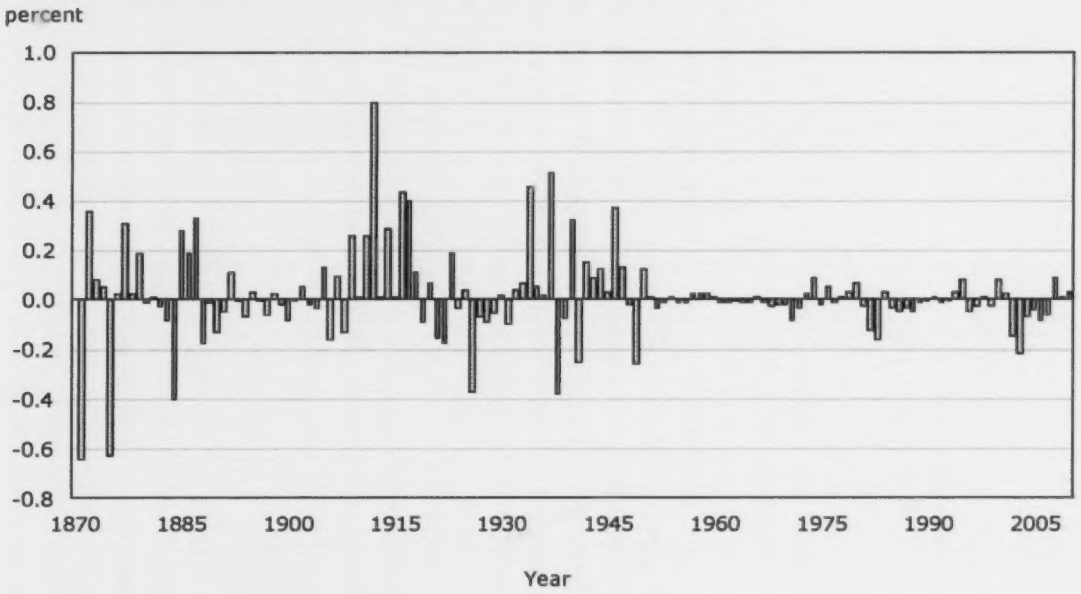
gains from changes in the real exchange rate. The nature of the interaction between the export balance and the real exchange rate is illustrated for a select set of years around the First World War (Table 1). In the period before that war, a negative trade balance, combined with declines in the real exchange rate, made a positive contribution to trading gains in 1911 and 1912. In contrast, a positive net trade balance in 1916 and 1917, along with an increase in the real exchange rate, led to a sharp rise in trading gains.

Chart 15
Real exchange rate index and contribution weight, 1870 to 2010



Source: Statistics Canada, authors' calculations.

Chart 16
Real exchange rate contribution to real GDI, 1870 to 2010



Source: Statistics Canada, authors' calculations.

In the inter-war period, the impact of the real exchange rate fluctuated from year to year as the net trade balance fluctuated. Also, the long downward trend in the real exchange rate ended, rising again after 1929. The Second World War saw further large increases in the contribution made by the real exchange rate. The post-Second World War period is characterized by relatively small contributions to the trading gains—both because the trade balance, while generally positive, was small, and because changes in the real exchange rate generally did not occur when the net trade balance was large.

Table 1
Real exchange rate: weight, log difference and contribution to real gross domestic income, 1910 to 1920

Year	Weight	Log difference	Contribution to real gross domestic income
		percent	
1910	-0.06	-0.10	0.00
1911	-0.09	-3.00	0.28
1912	-0.11	-7.50	0.82
1913	-0.11	0.00	0.00
1914	-0.07	-4.00	0.28
1915	0.00	-1.10	0.00
1916	0.04	10.70	0.44
1917	0.06	6.90	0.41
1918	0.06	1.80	0.11
1919	0.04	-2.20	-0.10
1920	0.02	3.60	0.09

Source: Statistics Canada, authors' calculations.

7.3 Difference between gross domestic product and gross domestic income and between gross domestic income and gross national income

An evaluation of the impact of trade needs to take into account both changes in the goods and services segment of the balance of payments and changes in the international income flows that were primarily related to capital investment. This is done here by considering first the difference between the growth rate of GDI and GDP and, second, the difference between the growth rate in real GDI and real GNI (Chart 17). The former provides a measure of the long-run trading gain; the latter is the long-run contribution from net income from abroad (NIFA).

From 1870 and to the early 1890s, the terms of trade caused trading gains to push real GDI some 8% higher than real GDP. Meanwhile, NIFA caused real GNI to fall behind real GDI by 3% over the same period. Increases in real income due to trading gains were partly offset by decreases in national income occasioned by greater capital outflows required to service capital borrowings that were needed for development. In the 1890s, trading gains continued but NIFA increased, reinforcing the overall increase in real income, partly because of a decline in British interest rates (Macintosh, 1939). Increases in trading gains associated with the First World War were also accompanied by increased capital servicing costs associated with wartime financing.

Chart 17
Long-run trading gain and NIFA contribution, 1870 to 2010

Source: Statistics Canada, authors' calculations.

Subsequently, the growth in real income from trading gains suffered a reversal in the 1920s, but moved steadily upward to 1945; so too did the contribution of NIFA. After the Second World War, real income from trading gains reached new highs, while the income effect from investment income flows remained basically constant. Increases after 2000 in real income from trading gains were accompanied by increases in the investment income flow as Canadians invested more abroad. But throughout the period, most of the advance in real income came from trading gains, not from changes in flows of NIFA.

8 Long-run effects of changes in trading gains

8.1 Cumulative gains in the difference between the growth of real gross national income and real gross domestic product

The net effect of changes in the terms of trade, the real exchange rate, and the net and gross trade balance is summarized in the overall trading gains—the difference between real income and real output measures.

The cumulative impact of the trading gains can be seen by measuring the cumulative gain in GNI relative to GDP across every decade (Chart 18). The path of smoothed gains is shown in Chart 19. The gains over this century and a half have been positive.

From 1870 to 1914, the difference steadily increased. Cumulative gains increased dramatically during the First World War, continuing the upward trend of the earlier period. While some of these gains were reversed in the early post-war period, a good portion was recouped by the growth spurt of the late 1920s. The recession of the early 1930s saw a short-term reversal that only partly offset these gains, and the upward growth trend was re-established in the late 1930s. Gains returned during the Second World War, and continued through the initial post-war period, and resumed again during the Korean War.

Chart 18
Cumulative gain in real GNI compared to real GDP, 1870 to 2010

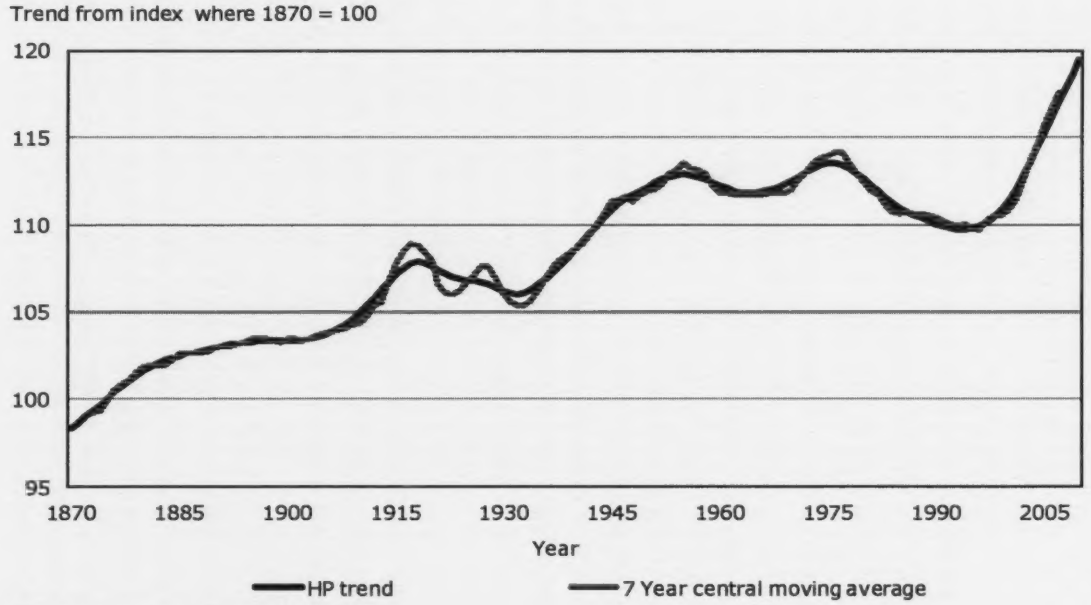
Source: Statistics Canada, authors' calculations.

The subsequent years saw few gains until the energy price rises of the 1970s. These increases were reversed over the long period of declining energy and resource prices that began in the early 1980s. The next upward movement occurred post-2000, when the world resource boom pushed up prices of both energy and metal products.

The gains made by 1900 gave real GNI a cumulative growth of 2.2% more than the growth of real GDP. This gap averaged a little over 6% during the 1920s and 1930s. By the late 1950s, it

had grown to 12%, and by 2010, 18%. There was a substantial cumulative impact of trading gains over the entire period.

Chart 19
Terms of trade trend, 1870-2010



Source: Statistics Canada, authors' calculations.

8.2 Decadal growth rates of gross domestic product, gross domestic income and gross national income per capita

Since 1870, trading gains have increased, while at the same time there has been substantial growth in real GDP. As a result, well-being has increased beyond that possible because of output growth alone. Annual growth in GDI per capita is generally higher than the growth in GDP per capita—though the amount varies over time. The average annual real GDP per capita growth over the entire period was 1.87%; the average annual real GNI per capita growth was 1.99%. Gains of real GNI relative to real GDP 0.12 percentage points per year cumulate over the time period into a gain of around 18%.

Cumulative annual growth rates of GDP per capita, trading gains per capita, GDI and GNI per capita for each of the decades since 1870 are shown in Table 2 and Chart 20.

The early period from 1870 to 1890 has often been regarded as a disappointment, in that average GDP growth rates were below those of the 1890-to-1910 period, when the western wheat economy grew rapidly. GDP per capita grew cumulatively by 33% in the first period, but 68% in the second. Despite the differences in GDP growth in the two periods, the trading gains were positive, and had the effect of increasing the cumulative gain in GDI per capita by an additional 7 and 4 percentage points in each period—a substantial gain relative to the increase in the production capacity provided by the GDP-per-capita measure.

GNI per capita measures are very slightly lower than GDI in the period before 1890 and about the same from 1890 to 1920.

The second decade of the century saw a slowdown in overall growth in GDP per capita to only -0.38% per year, but the trading gains contribution was 0.52% per year, making GDI per capita positive rather than negative. Most of the gains in absorption during this decade came as a result of trading gains rather than production capabilities. This same trend remerged in the 1930s, when GDP growth was negative but trading gains produced a positive growth in GNI per capita. In both these periods, real GNI per capita growth was slightly higher than real GDI per capita growth.

Table 2
Comparison of real income measures, compound annual growth rates

Period	Population	Real gross domestic product per capita	Trading gain	Real gross domestic income per capita	Real gross national income per capita
			percent		
1870 to 2010	1.62	1.87	0.12	1.99	1.99
1870 to 1879	1.73	0.14	0.33	0.48	0.33
1880 to 1889	0.99	1.99	0.31	2.27	2.16
1890 to 1899	0.89	1.78	0.09	1.90	1.89
1900 to 1909	2.81	2.91	0.29	3.20	3.21
1910 to 1919	1.91	-0.38	0.52	0.13	0.15
1920 to 1929	1.69	3.16	0.06	3.24	3.19
1930 to 1939	1.14	-0.06	0.06	-0.01	0.03
1940 to 1949	1.81	2.96	-0.01	2.95	3.17
1950 to 1959	2.76	1.98	0.06	2.05	2.12
1960 to 1969	1.79	3.42	-0.06	3.36	3.39
1970 to 1979	1.43	2.80	0.25	3.06	2.92
1980 to 1989	1.17	1.90	-0.12	1.78	1.70
1990 to 1999	1.08	1.60	-0.14	1.44	1.47
2000 to 2010	1.06	0.80	0.45	1.26	1.35

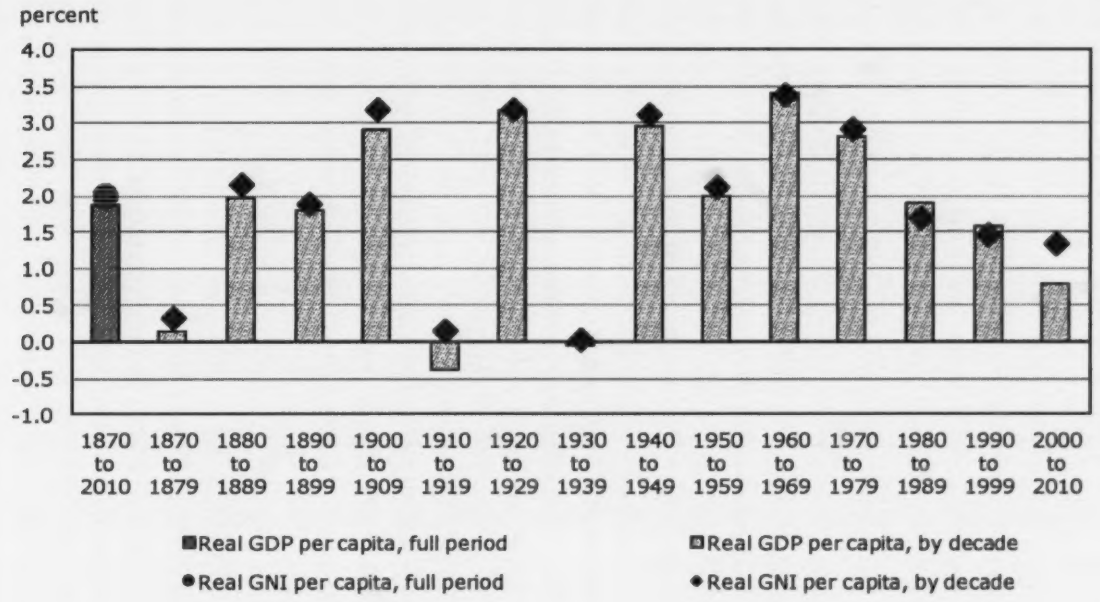
Source: Statistics Canada, authors' calculations.

The 1920s saw a positive increase in GDP and smaller trading gains, but this must be placed in the context of the rapid gains made in the previous period. The 1920s, despite their severe decline in trading gains early in the period and then gains later, essentially consolidated the earlier increases. Canadian trading gains exhibited hysteresis effects. Trading gains showed signs of an upward ratchet effect—each set of gains led to higher permanent levels of real income.

After the Second World War, a new pattern emerged: decadal gains were followed by decadal losses. Immediately after the war in the 1950s, trading gains produced a positive growth rate in GDI per capita that was slightly higher than the growth in GDP per capita in the 1950s. This was followed by a small trading gain loss in the 1960s that cumulated to a net gain over the two decades. The ratchet upward to the next, higher level was occasioned by a large increase in the 1970s as the relative prices of oil and natural resources increased. During this period, growth in real GNI per capita was slightly higher than real GDI.

There was then a long hiatus during the 1980s and 1990s when trading gains declined, primarily as a result of a fall in the relative prices of natural resources. The successive declines in trading gains during the 1980s and 1990s were unusual in historical context (Chart 20). They are also decades when the post-war increase in overall growth of output and productivity slowed down markedly (Baldwin and Gu, 2007). Three of the four decades where trading gains made a negative contribution came after the Second World War; the other was the 1940s.

Chart 20
Real GDP per capita versus real GNI per capita, compound annual growth rates



Source: Statistics Canada, authors' calculations.

Post-2000, large positive trading gains once again pushed the overall index to a new high. And reversals of international capital movements coming from recent increases in Canadian direct foreign investment abroad led to slightly higher real GNI than real GDI growth. During this period, trading gains accounted for about half of the overall growth in real income measures.

In summary, growth in real income was generally higher than growth in real output over the post-Confederation period. And most of this is encapsulated in the trading gains on the goods and services side of the balance of payments. Consideration of the income flows from interest and dividends accounts has much less impact on real income growth.

9 Conclusion

This paper focuses on how long-run trends associated with resource dependence have affected the Canadian economy. Finding ways to directly measure the connection between an economy's emphasis on resources and overall economic well-being has provided a challenge to much of the discussion regarding the benefits of resource-based economies. This paper looks at one aspect of this debate—how the terms of trade between Canada's exports, which have consisted mainly of natural resources or processed resources and its imports, have affected Canadian real income.

The study tracks long-run developments in the terms of trade that have sprung from Canada's reliance on resource exports and their impact on overall output. It examines the evidence on movements in the terms of trade and their relation to changes in real income. Initially, the paper focuses on the evolution of successive waves of resource development and the prices of individual products that make up the terms of trade. Since 1870, a succession of resources has fuelled economic development: agricultural and animal products; forestry (logs, timber, lumber and pulp and paper); non-ferrous metals (zinc, copper, lead, nickel and gold) as well as iron ore, uranium and diamonds; electricity; and petroleum and natural gas. While these developments taken together speak to the importance of the resource economy in Canada, they also provide an amount of detail that makes it difficult to evaluate their overall importance on the issue at hand—the extent to which a focus on resources contributed to Canadian well-being.

The paper moves beyond historical detail to generate a summary measure that cumulates the individual series at the aggregate level. This statistic helps evaluate the overall effect of changes in trading gains and, in particular, the terms of trade on well-being. To do so, it uses standard measures arising from the SNA, and asks how improvements in the terms of trade have affected trading gains and increases in real national income. While the measure that is adopted here has been used to examine the benefits of changes in the terms of trade in the post-2000 period (Macdonald 2010), it has not previously been applied to provide a longer historical perspective.

The paper therefore focuses on a summary measure that directly gauges the improvement in economic well-being that arises from increases in the relative prices of exports—real GNI. This is a measure of the real product that can be absorbed (consumed and invested) as opposed to the real output that is produced—real GDP. This measure depends both on changes in GDP and on the terms of trade, enabling us to capture how Canadian well-being has been affected by Canadian exports, primarily natural resources. Ceteris paribus, GNI increases faster than GDP when prices of exports increase relative to imports, since this allows exports, which are part of domestic production, to be exchanged for more imports, part of domestic absorption.

The approach adopted here of focussing on increases in real income has several advantages. The first is that it provides a direct measure of a volume concept that is relevant to the issue at hand and it does so in a more comprehensive way than just an examination of the terms of trade. The terms of trade is only a price ratio and does not capture quantity. Differences between real income and real GDP stem from a term that takes into account not only the terms of trade but also the size of trade.

Nevertheless, the summary measure used here is not without certain drawbacks. As a summary measure, it does not provide the type of detail that needs to accompany the history of events. To understand the underlying components, accompanying detail is needed showing what was happening to the growth of individual commodities and their relative prices. The sketch of developments that accompany the macro approach adopted in this paper provides historical detail and corroborative context.

But, perhaps more importantly, it must be recognized that the summary measure of changes in the quantity of real income suffers problems that apply to all index numbers measuring long-term growth. Index number theory is used to generate indexes of aggregates from diverse commodities, and the weights used to aggregate these diverse commodities are chosen to enable comparisons over time. To some, comparisons between end points that are far removed in time are less meaningful. If so, comparisons using these series over many decades become more problematic—though that problem applies to measures of both GDP and GNI.

Of equal importance to an evaluation of long-run comparisons, such as those contained herein, is that statistical systems have changed over time. The quality of the data differs for the periods before 1925, from 1926 to 1961 and after 1961.

Nevertheless, the portrait of the extra growth that international price movements have generated for measures of Canadian real income is impressive. From 1870 to 2010, the cumulative growth in the volume of national income is 18% larger than the more common measure of production, real GDP. The pattern is one of a long, initial 50-year period of positive growth in the gap between real GNI and real GDP. This was followed by spurts associated with the two world wars that were partly, but not fully, offset by subsequent reversals. More recently, the 1970s and the post-2000 petroleum and resource booms increased the difference between real income and real GDP. To some, the resource economy is a boom-and-bust phenomenon. Sharp upward increases have been followed by reversals. But the gains have not been completely offset, and the end result is a long-run growth of real income, and a long-run positive and significant contribution from trading gains.

The finding is important for several reasons. First, it illustrates that concentration on resources does not necessarily doom an economy to a decline in its terms of trade over the long run. Second, it speaks to the rate of growth that can be expected of a successful resource economy. Emery and Boyce (2011) develop a dynamic general equilibrium model with resource production, showing that to have continued income growth from resource production the economy must have continued growth in the terms of trade ratio. In the long run, per capita incomes in the economy converge from above to the income level associated with a non-resource economy—unless the terms of trade increase.

10 Appendix

10.1 Long-run national accounts aggregates

The historical data from Statistics Canada's National Income and Expenditure Accounts, which covers the years 1926 to 1986, provides an overlapping period that can be used to assess the comparability of historic and modern data. No overlapping period exists for the link between Urquhart's work and Statistics Canada's modern publications. All data are measured against GDP, which means that export and import measures include services estimates and the merchandise trade transactions discussed in the trade data appendix, as well as balance of payments adjustments for inland freight and insurance.

Using these three publications requires us to assume the data are comparable across sources when methodological differences arise. The differences are more pronounced for price and volume indexes than for nominal estimates, but differences in the concepts behind GDP measurement do arise across publications. These differences are often a result of revisions to the SNA, the international manual for calculating GDP.

A further challenge arises when real GDI and real GNI are calculated. They are deflated using an FDE deflator that cannot be calculated based on source data for historical estimates, and which was not routinely published in historical accounts. The FDE deflator is therefore inferred based on knowledge of how an expenditure-based GDP price index is constructed. In particular, a Tornqvist version of the expenditure-based GDP price index can be written as:

$$d\ln P_{t/t-1}^{GDP} = \upsilon_t^{FDE} d\ln P_{t/t-1}^{FDE} + \upsilon_t^{X} d\ln P_{t/t-1}^{X} - \upsilon_t^{M} d\ln P_{t/t-1}^{M}. \quad (3)$$

Based on this aggregation, the path of the FDE deflator can be inferred by accounting for the effects of exports and imports:

$$d\ln P_{t/t-1}^{FDE} = \left({}^{1}\!/_{\upsilon_t^{FDE}} \right) \left(d\ln P_{t/t-1}^{GDP} - \upsilon_t^{X} d\ln P_{t/t-1}^{X} + \upsilon_t^{M} d\ln P_{t/t-1}^{M} \right). \quad (4)$$

This manipulation to produce an FDE estimate relies on the assumption that both the GDP and the export and import price indexes employed are suitable for this purpose.

10.1.1 Nominal estimates

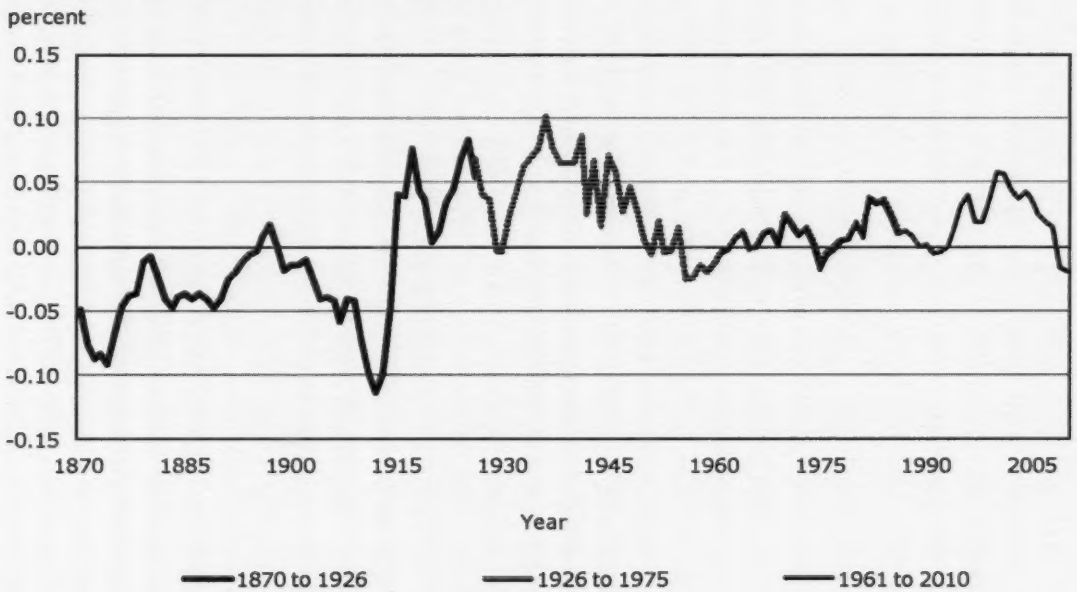
Nominal estimates of GDP, exports, imports and NIFA are not directly linked into time series for the paper. Rather, they are employed only as weights and adjustments for index and real income calculations. The average of the share of exports and imports in GDP and net exports to GDP are presented in Charts 21 and 22.

Across all three data sources, the ratios do not suggest that differences in measurement through time lead to inconsistencies in the share of GDP related to trade variables. For 1961 to 1986, when Statistics Canada data series overlap, the estimates are nearly identical. The ratio estimates in 1926 from both Urquhart and Statistics Canada are indistinguishable.

Chart 21
Average of export and import shares in GDP, 1870 to 2010

Source: Statistics Canada, author's calculations based on Urquhart.

Chart 22
Net export share of GDP, 1870 to 2010



Source: Statistics Canada, author's calculations based on Urquhart.

Estimates of NIFA are used to raise or lower GDP to move to GNI. Across the three data sources, NIFA appears consistent as a share of GDP and, in fact, is consistent in terms of levels at linking points.

10.1.2 Price and volume indexes

Price and volume indexes present more of an issue for linking than do nominal series. Historical data sources used fixed-base-year indexes, while modern series are chained Fisher indexes. The fixed-base indexes produced for the historical estimates are known to be less than ideal because the structure of prices in the economy changes through time and is not reflected in the index. Nevertheless, to produce a long-run index of real GDP, the terms of trade, the real exchange rate or real income, historical and modern data sources must be linked—it is not possible to re-aggregate historical data sources to match modern methodologies. In many cases, the source data used to create historical aggregates has either been lost when researchers pass away or data files are deleted or destroyed. The result is that the detailed historical data needed to produce modern chained indexes no longer exists.

Although it is possible to use modern data sources to match historical aggregation techniques rather than employing modern data, this was not done in this paper for several reasons. First, the modern data are employed widely for many purposes. By using the modern data, the results from the paper for 1961 to 2009 are directly comparable with previously released studies on Canada's economic growth. Second, by using the modern data, the results of the paper can be re-created by interested parties at minimal cost. They do not need access to Statistics Canada's confidential input–output tables. Third, the chained Fisher estimates are the most accurate indexes Statistics Canada produces. By moving to a historically employed methodology, the paper would be directly creating measurement errors in the period after 1960. This period covers the computer revolution and the accompanying significant changes in relative prices. The penalty for not adjusting price structures during this period would be too large if a fixed-base index were to be employed. The results are price and volume indexes based on different types of indexes being linked through time.

For each of the price and volume series employed in the paper, the calculations are made separately based on the data contained in Urquhart (1993), Statistics Canada's *National Income and Expenditure Accounts: Annual Estimates, 1926-1986* and Statistics Canada's modern time series. Each data source and the accompanying manipulations are addressed individually.

10.1.2.1 Urquhart's 1993 estimates

Urquhart's estimates are based on the sparsest data sources and, in many ways, presented the greatest challenge in construction. Once he compiled estimates of nominal GDP and nominal GNI, Urquhart chose to use deflators based solely on cost of living and gross fixed capital formation to produce real volume estimates. On page 6, he states:

> The current dollar values were deflated at a quite aggregate level to obtain estimates in constant dollars. The cost of living index, used to deflate all national expenditures except gross fixed capital formation was, in part, a product of this project [the GNP estimates for 1870 to 1926]. The capital formation items were deflated at a more disaggregated level by indexes developed by Statistics Canada.

Urquhart based his aggregate deflator on consumption and investment prices and excluded information on export and import prices. As a result, Urquhart's deflated series are not production series but domestic absorption series consistent with what is now called real GDI and real GNI. The real GDP series in Urquhart is not consistent with the real GDP estimates in later publications because it treats the terms of trade as a volume movement rather than a price movement.

Urquhart provides an estimate of the FDE deflator for 1870 to 1926. We combine Urquhart's FDE price index estimate with the export and import price indexes produced by Michell and Taylor (1931), using the nominal values published by Urquhart to produce a GDP deflator. A Tornqvist index is used to aggregate the FDE, export and import indexes into an aggregate GDP deflator using Equation (3).

10.1.2.2 Statistics Canada's National Income and Expenditure Accounts: Annual estimates, 1926 to 1986

National Income and Expenditure Accounts: Annual Estimates, 1926-1986 provides a set of balanced national accounts estimates for GDP and NIFA. The nominal estimates are deflated using price indexes updated periodically to reduce bias due to relative price movements. The deflator uses six indexes linked together and set to a 1981 base. The six indexes use 1935 to 1939, 1949, 1957, 1961, 1971 and 1981 as bases to deflate nominal expenditures for 1926 to 1947, 1947 to 1956, 1956 to 1961, 1961 to 1971, 1971 to 1981 and 1981 to 1986, respectively.

The updating produces indexes of higher quality than those produced for Urquhart's work, which faced significant data constraints far above those faced by Statistics Canada. While he attempted to produce price indexes that were as close as possible to the price structures of aggregates being deflated, the gaps between re-basing periods allow for some bias in the indexes, particularly if rapid relative price shifts occur.

The value and price index estimates from the annual estimates were used to produce an estimate of the FDE deflator for the paper using Equation (4).

10.1.2.3 Statistics Canada's modern national accounts estimates

Statistics Canada's current procedures produce a balanced set of GDP and net income along with price indexes based on a chain Fisher methodology—a distinct break from historical methodologies. The modern data are employed as they are published publicly, and the FDE deflator is inferred from the aggregate indexes based on Equation (4).

10.1.2.4 Linking procedures and analysis

The required price and volume series are then linked using 1926 = 100, chosen because Urquhart and Statistics Canada's *National Income and Expenditure Accounts: Annual Estimates, 1926-1986* overlap in that year. The modern chained Fisher indexes are set equal to the value from the annual estimates for 1961. The results for real GDP, real GDI, real GNI, the terms of trade, the real exchange rate and the contribution to real GNI from NIFA are presented in Charts 23 through 28.

The link between Urquhart's data for 1870 to 1926 and Statistics Canada's annual estimates provides no overlap, so it must be assumed that the data are conformable. The link between Statistics Canada's annual estimates and its modern data series provide an overlapping period of 26 years. During this period there is a divergence between the fixed-base historical index and the modern chain Fisher index. A divergence is expected because it is known a priori that even though the fixed-base historical index is periodically updated, it will be biased relative to the ideal Fisher index. The overlapping periods show a pattern of divergence, which in this case manifests itself as a more rapid increase in the real income measures using the historical data than is shown using the Fisher index.

The unanticipated result is that the divergence is fuelled by events in the 1970s, and that growth rates between the historical and modern sources are more similar in the 1960s than after 1980 (Table 3).

This pattern may not hold for two reasons. First, an index with fixed bases that are periodically updated does not adjust to relative price movements. Therefore, the effect of the 1973 and 1979 oil shocks and the 1986 oil price collapse may be leading to unusual divergences between the indexes, based on the short-run dynamics introduced by the rapid swings in energy prices. Second, the 1997 revision to the SNA affected the data in a number of ways: removing time series breaks, changing index aggregation techniques and adjusting concepts. The revisions were important, and led to a change that removed the 1975 recession in expenditure-based real GDP estimates. The data employed by Bodman and Crosby (2000) and Cross (1996) in their studies of the Canadian business cycle have an additional recession in 1975 that is not captured in the database employed by Demers and Macdonald (2006) in their subsequent study. This revision means that the historical and modern data series are based on incompatible source data, and appear to have heavily affected the 1970s. The revision can potentially explain why the 1970s data shows larger differences relative to the historical data.

Regardless of the reason for the differences, the historical and modern series are based on different methodologies, and will not be exactly comparable. The comparison across real income measures, however, will contain the same form of bias from historical methodologies in each data vintage. As a result, the type of comparison across income measures employed in the study can still provide valuable insight into the growth process, the terms of trade and the role of resources. At no point in time is a Fisher index for one real income measure compared with a fixed-base index for another measure. However, a potential issue does arise in estimates of the long-run compound annual growth rate. However, all real income measures are going to be affected by the bias in the same direction, and so it is unlikely that this source of measurement error will negate findings based on differences between real income measures.

While the dataset we have constructed is imperfect, the issue is whether the measurement error contained therein creates sufficient problems that the data are unusable for the purpose at hand. Certainly the linked data could be employed in a regression setting because instrumental variables techniques exist to address measurement error. But whether the data can be employed to look at the growth process based on growth rates calculated from indexes will depend on a user's comfort level with the linking procedures we have employed.

Maddison (2003) has created several long-run time series that have been used extensively for analysis of national accounts aggregates. These datasets are published by the OECD and contain real GDP per capita estimates in 1990 dollars, adjusted for purchasing power parity (PPP). His dataset has been used to examine convergence across a wide range of countries both in terms of growth rates and in terms of PPP-adjusted levels. His dataset contains an estimate of real GDP per capita for Canada from 1870 to 2008. A comparison between our real GDP per capita index and the PPP-adjusted level of real GDP per capita estimated by Maddison shows no difference (Chart 29). The compound annual growth rate from 1870 to 2008 from Maddison's estimate of real GDP growth for Canada is 1.98%; the compound annual growth rate from our index linking is 1.87%. If we treat the estimates from Urquhart as real GDP estimates rather than real GDI estimates, we would have a compound annual growth rate of 1.99%, nearly identical to Maddison's estimate. The patterns in the data through recessions, wars, booms and busts are nearly identical. In short, the methodology employed by Maddison and our methodology produce consistent results.

We believe that both our linking procedure produces long-run estimates of real income and the constituent components examined in the paper that are of sufficient quality to make inferences about how the terms of trade have influenced the path of real income growth in Canada and to demonstrate its magnitude. While we do not believe we can be accurate to multiple decimal places (because there will necessarily be some bias in our dataset due to our inability to re-aggregate historical data to match modern standards), we do believe that our dataset is sufficiently accurate to gain a sense of how large a contribution relative price changes and NIFA

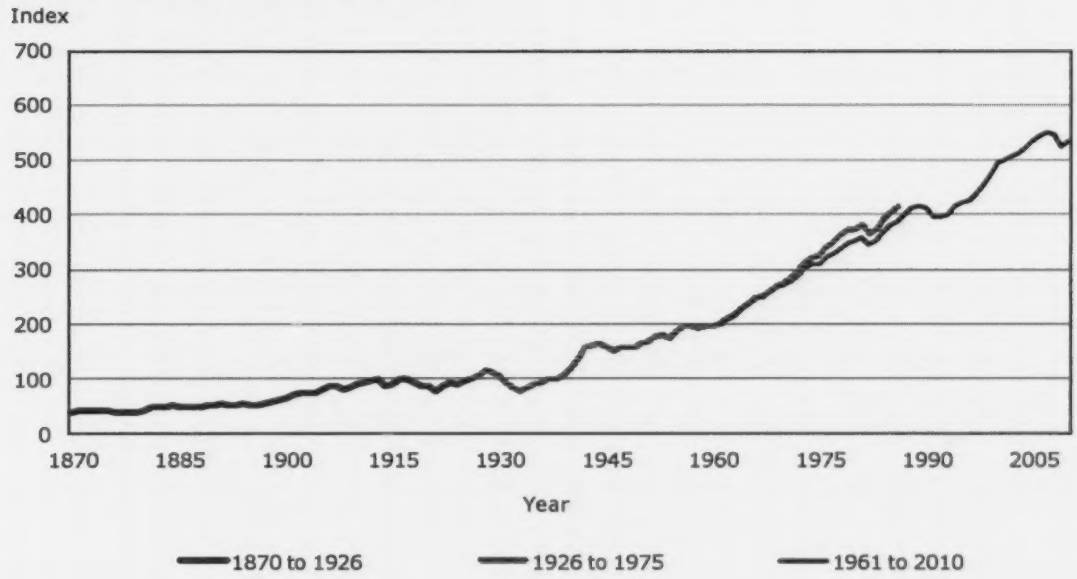
make to Canada's real income growth. In this regard, we are able to almost completely account for features of the flows in the current account. We can therefore provide a more detailed and richer understanding of how Canada's role as a trading nation, and its significant resource base, have influenced its growth in real income and the difference between this concept and the growth in real GDP. At this time, there does not appear to be an alternative to the type of methodology we have employed, and we have produced results consistent with the work of Maddison. In the end, because there are limited means for assessing the biases in historical indexes—where they do not overlap with current data collection systems—one is forced to make a value judgment. Either the historical data can be employed to produce long-run data that has utility for understanding the Canada's economic growth or it cannot, and we have no means of constructing a continuous narrative for our nation's real income growth.

Table 3
Historical data versus modern data, compound annual growth rates

	Historical Statistics Canada data	Modern Statistics Canada data	Modern less historical
		percent	
Real gross domestic product per capita			
1961 to 1970	3.58	3.48	-0.10
1970 to 1980	3.13	2.63	-0.50
1980 to 1986	1.79	1.62	-0.17
1961 to 1986	2.97	2.69	-0.28
Real gross domestic income per capita			
1961 to 1970	3.58	3.48	-0.10
1970 to 1980	3.55	2.89	-0.67
1980 to 1986	1.38	1.12	-0.25
1961 to 1986	3.04	2.68	-0.36
Real gross national income per capita			
1961 to 1970	3.61	3.52	-0.09
1970 to 1980	3.45	2.76	-0.69
1980 to 1986	1.34	1.00	-0.34
1961 to 1986	3.00	2.61	-0.39
Net income from abroad contribution			
1961 to 1970	0.03	0.03	0.00
1970 to 1980	-0.10	-0.13	-0.02
1980 to 1986	-0.04	-0.12	-0.08
1961 to 1986	-0.04	-0.07	-0.03
Terms of trade			
1961 to 1970	0.05	0.08	0.04
1970 to 1980	1.58	1.02	-0.56
1980 to 1986	-1.24	-1.62	-0.38
1961 to 1986	0.35	0.05	-0.30
Real exchange rate			
1961 to 1970	-1.14	-1.37	-0.23
1970 to 1980	1.12	2.41	1.30
1980 to 1986	-3.48	-2.39	1.09
1961 to 1986	-0.82	-0.12	0.69

Source: Statistics Canada, authors' calculations.

Chart 23
Real GDP per capita, 1870 to 2010



Source: Statistics Canada, author's calculations based on Urquhart.

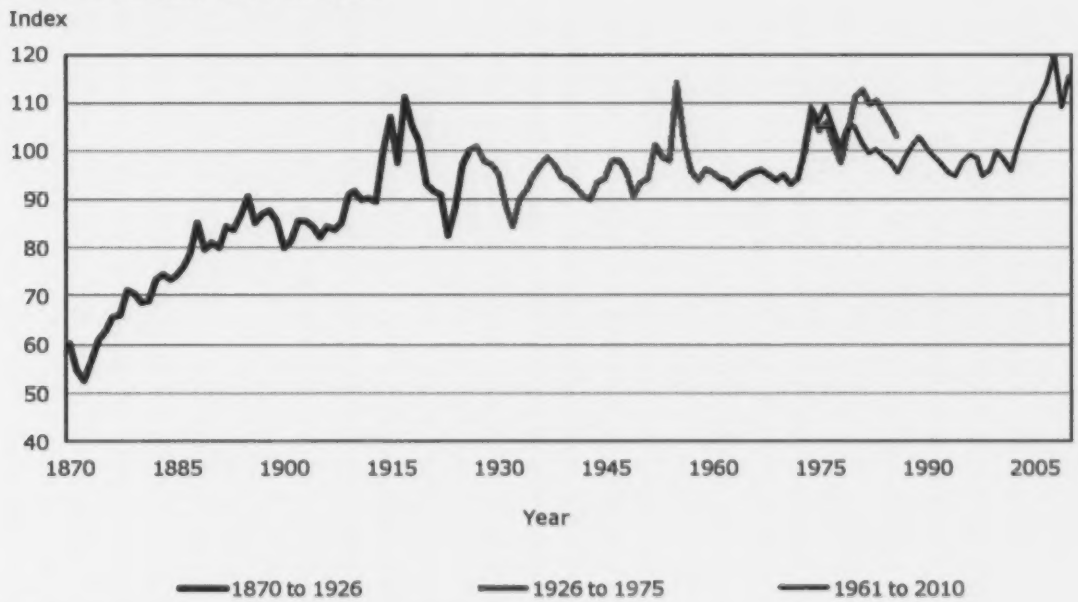
Chart 24
Real GDI per capita, 1870 to 2010

Source: Statistics Canada, author's calculations based on Urquhart.

Chart 25
Real GNI per capita, 1870 to 2010

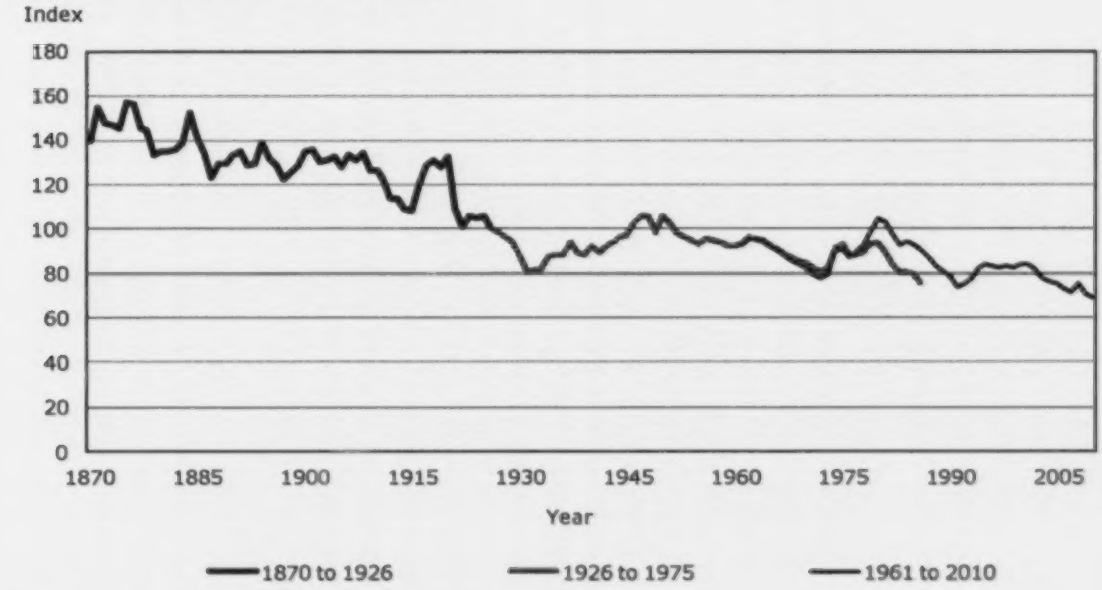
Source: Statistics Canada, author's calculations based on Urquhart.

Chart 26
Terms of trade, 1870 to 2010



Source: Statistics Canada, author's calculations based on Urquhart.

Chart 27
Real exchange rate, 1870 to 2010

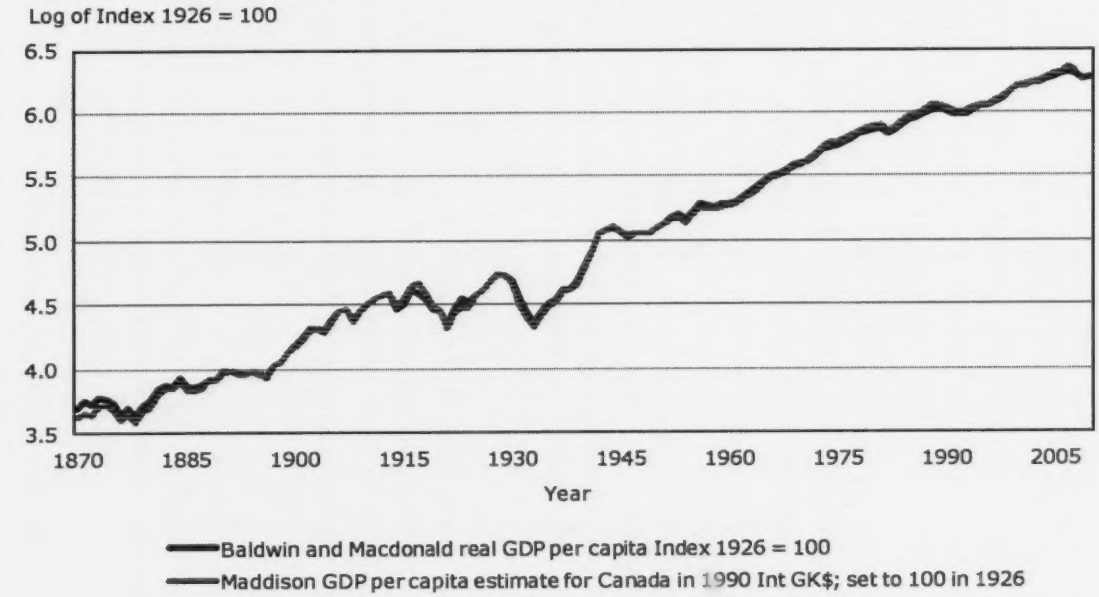


Source: Statistics Canada, author's calculations based on Urquhart.

Chart 28
Contribution of NIFA to real GNI, 1870 to 2010

Source: Statistics Canada, author's calculations based on Urquhart.

Chart 29
Real GDP per capita estimates, Baldwin and Macdonald versus Maddison



Note: Madison's estimate is in PPP-adjusted 1990 international dollars. His series is set to 100 in 1926 to facilitate the chart. No level comparisons are made, only growth rates.
Source: Maddison, authors' calculations.

10.2 Import and export data

The goal of this study is to investigate the effect of resources, relative prices and international income flows on growth in Canadian real income. To facilitate this goal, long-run time series must be produced. To do so, historical aggregations must be employed as long as the historical data remain in paper format. Without digitizing the historical trade volumes, which has a prohibitive cost, the historical aggregations must be employed as is: it is not possible to re-aggregate historical data to match modern classification systems.

It is, however, possible to re-aggregate modern series to match the historical data. This re-aggregation can be done in one of two ways. The first, which was not used in this paper, is to go to confidential microdata files and re-aggregate based on the microdata.

The second is to take the modern series as published and aggregate to match the historical classification. The historical classification is based on eight commodity groups, making this method feasible with some effort. The second method is able to produce results consistent with historically produced estimates from the Dominion Bureau of Statistics (DBS). Moreover, the second approach carries the added benefit that, because it is based on published data, the results, methodology and data sources can be released to researchers and interested parties. Additionally, the use of publicly available data means that should one desire it, an updated version of the paper can be produced without recourse to confidential data by individuals outside of Statistics Canada. The second method was deemed more useful to the research community and interested parties because it potentially provides them with a much richer data source than an aggregation based on microfiles because, for example, interested parties are able to look into the various aggregations themselves.

10.2.1 Long-run data sources

Long-run data series are based on Michell and Taylor (1931) for the years 1870 to 1890, *Trade of Canada* 1939 for the years 1891 to 1926 and *Trade of Canada*, Volume 1, from 1940, 1945, 1950, 1955, 1959/1960 and 1962 for the years 1926 to 1962. Data from the Summary Export Group (SEG) publications (CANSIM table 226-0001) and Summary Import Group (SIG) publications (CANSIM tables 226-0009 and 226-0002) are employed for 1963 to 1985. In specific cases that are detailed below, additional data are employed from SEG and SIG (for the years after 1985) and from the Strategis database maintained by Industry Canada. The majority of the data used after 1985 comes from Statistics Canada's merchandise trade release (CANSIM table 228-0003).

Data prior to 1963 are not in electronic format. The DBS and Taylor and Mitchell used aggregates consisting of agricultural and animal products; fibres and textiles; wood products and paper; iron, steel and products; non-ferrous metals and products; non-metallic minerals and products; chemicals and fertilizer; and miscellaneous products. The aggregates reported in official publications and in Taylor and Mitchell remain stable for 1870 to 1960. Data from 1870 to 1960 for published aggregates were digitized.

No electronic data exists for 1961 and 1962, nor did the DBS publish value totals for those years. Instead, the DBS indexes based on nominal values for 1960, 1961 and 1962 published in the December 1962 issue of *Trade in Canada* were used. Published index values represent the growth rates from 1960 to 1961 and from 1961 to 1962. They are used to interpolate forward from the 1960 levels to produce level estimates for 1961 and 1962.

After 1963, a new commodity classification code was used that differed substantially from the previous classification, resulting in a break in the data. Using SEG and SIG data, merchandise

trade data and Strategis data, it is possible to re-aggregate modern data series into series that closely match the historical aggregations.

The re-aggregation of data after 1963 poses an issue with the granularity of the data. The merchandise trade data is published on a Major Group basis, which has less detail than SEG and SIG data. The merchandise trade data, therefore, formed the starting point for the re-aggregations. After the merchandise trade data had been re-aggregated to match the DBS historical aggregation classifications, the SEG data was re-aggregated to match both the DBS aggregations and the merchandise trade data. Additional data from Strategis was employed where specific commodity groups have been combined into merchandise trade Major Group classifications and needed to be broken out. The result is a continuous time series spanning 1870 to 2009.

10.2.2 Commodity classifications and concordances

The historical commodity classifications used by Taylor and Mitchell and the DBS fall into eight categories: agricultural and animal products; fibres and textiles; wood products and paper; iron, steel and products; non-ferrous metals and products; non-metallic minerals and products; chemicals and fertilizer; and miscellaneous products. These categories are essentially constant from 1870 to 1962.

The concordance between the modern data and the historical commodity classification is presented in Figure 2. The concordance is based on SEG and SIG data, as the degree of granularity is sufficiently detailed that a reasonable understanding of what commodities are in which aggregates can be gained.

In generating the concordance, some issues must be addressed about specific commodities. The structure of production and exports changes a great deal over the 139 years covered by the study, and aggregating the data using a constant set of criteria over the entire period is challenging. For example, historically, coal is treated as a non-metallic mineral export. Coal was the largest energy commodity traded in the early part of the period. To maintain the energy component of non-metallic minerals, natural gas and crude oil are also classified as non-metallic minerals. Further, rubber historically came from rubber trees, making it an agricultural commodity. However, advances in technology and processes allowed for synthetic rubbers to be derived from petroleum products. As a result, rubber goes from being an agricultural commodity in the early part of the period to being classified as a chemical product in the latter part of the period.

The major drawback of having to use the historical DBS aggregation schema is the grouping of products from different points on the production process into commodity groupings based on major materials proportions. For example, 'iron, steel and products' includes iron ore, steel ingots, farm machinery and ships. This groups raw materials inputs with outputs containing large amounts of the inputs. This complicates examination of the data. Nevertheless, knowledge of Canada's production processes and development path provides sufficient information to draw reasonable inferences. Since 1870, Canada has tended to import more finished products and export raw and semi-finished materials. This does not mean that there are no agricultural imports or that there are no finished or manufactured products exported. Rather, the data show that, on balance, Canada has tended to pay for its machinery and equipment and consumer products with staple exports. Data after 1963 can be decomposed into more detail, and this is done where necessary for motor vehicles and parts; aircraft and parts; electricity; and television, communications and related equipment.

The data from Taylor and Mitchell, the DBS, SEG and SIG are customs-basis domestic exports. The merchandise trade data is provided on a customs basis; however, it includes re-exports.

This creates a serious distortion in the data after 1985. Data on re-exports from SEG data and from the Strategis database at Industry Canada are used to generate an estimate of re-exports for the years 1963 to 2009.

The miscellaneous category needs a special mention because it is measured residually as total domestic exports less the sum of all other export categories (e.g. agricultural and animal products; fibres and textiles; wood products and paper). The resulting miscellaneous category includes the value of all exports and imports not explicitly accounted for in the re-aggregation to DBS historical categories plus the value of special transactions.

The re-aggregation and linking procedure can produce results that are remarkably consistent over time. The log-values for exports are presented in Charts 30 through 37, while the log-values for imports are presented in Charts 38 through B45. The phase shift between fiscal year data (in publications prior to 1941) and calendar year data (in publications after 1940) can be seen where the DBS data spanning from 1891 to 1939 overlaps with the DBS data spanning from 1926 to 1960. Because we are interested in shares of exports represented by these commodities, merging calendar- and fiscal-year data directly does not create a problem—it has little impact on the results. Where data series overlap, the simple rule is followed that the most modern data are employed first. However, an exception is made when historical data cover periods not captured by more modern data sources. An example is exports of textiles and fibres, where the modern merchandise trade data are only employed back to 1990 due to data limitations. Data for apparel exports are not provided separately in the merchandise trade data; they are taken from the Strategis database at Industry Canada, which begins in 1990.

Figure 2
Commodity concordance based on summary export group and summary import group commodity classifications[1]

Re-aggregated exports contain	Re-aggregated imports contain
Agricultural and Animal Products Live animals; Food, Feed, Beverages and Tobacco; Hides, Skins and Furs; Oil Seeds; Other Crude Animal Products; Seeds for Sowing; Other Crude Vegetable Products; Oils, Fats, Waxes, Extracts and Derivatives; Leather and Leather Fabricated Materials;	**Agricultural and Animal Products** Live Animals; Food, Feed, Beverages and Tobacco; Oil Seeds; Furs and Skins Undressed; Other Crude Animal Products; Other Crude Vegetable Products; Leather and Leather Fabricated Materials; Vegetable Oils, Fats, Waxes, Extracts and Derivatives; Other Oils and Fats, Except Essential Oils;
Fibres and Textiles and Textile Products Textile and Related Fibres; Textile Fabricated Materials; Apparel and Accessories; Footwear;	**Fibres and Textiles and Textile Products** Cotton; Wool and Man-Made Fibres; Yarn, Thread and Cordage; Broad Woven Fabrics, Cotton; Broad Woven Fabrics Excluding Cotton; Other Textile Materials; Apparel and Accessories Including Footwear;
Wood, Wood Products and Paper Crude Wood Materials; Lumber; Veneer and Plywood; Newsprint; Other Paper and Board; Shingles and Shakes; Other Sawmill Products; Other Wood Fabricated Materials; Printed Matter;	**Wood, Wood Products and Paper** Crude Wood Materials; Paper and Paperboard; Lumber; Veneer; Plywood and Wood Building Boards; Wood Pulp and Similar Pulp; Books and Pamphlets; Other Printed Materials;
Iron and Its Products Iron Ores, Concentrates and Scraps; Primary Iron and Steel; Plate, Sheet and Strip Steel; Other Iron and Steel; General Purpose Machinery; Material Handling Machinery; Drilling, Excavating and Mining Machinery; Agricultural Machinery, Including Tractors; Other Machinery; Total Motor Vehicles and Parts; Transportation Equipment; Other Equipment and Tools;	**Iron and Its Products** Iron Ores, Concentrates and Scraps; Plate, Sheet and Strip Steel; Other Iron and Steel and Alloys; Bolts, Nuts and Screws; General Purpose Machinery; Material Handling Machinery; Drilling, Excavating and Mining Machinery; Machine Tools, Metal working; Other Metalworking Machinery and Equipment; Textile Industries Machinery; Mechanical Power Transmission Equipment; Farm Machinery; Tractors; Special Industry Machinery; Total Road Motor Vehicles and Parts; Transportation Equipment; Air Conditioning and Refrigeration Equipment; Electric Light and Distribution Equipment; Other Measuring, Laboratory Equipment; Miscellaneous Measuring Equipment; Navigation Equipment; Other Equipment and Tools;

See source at end of Figure.

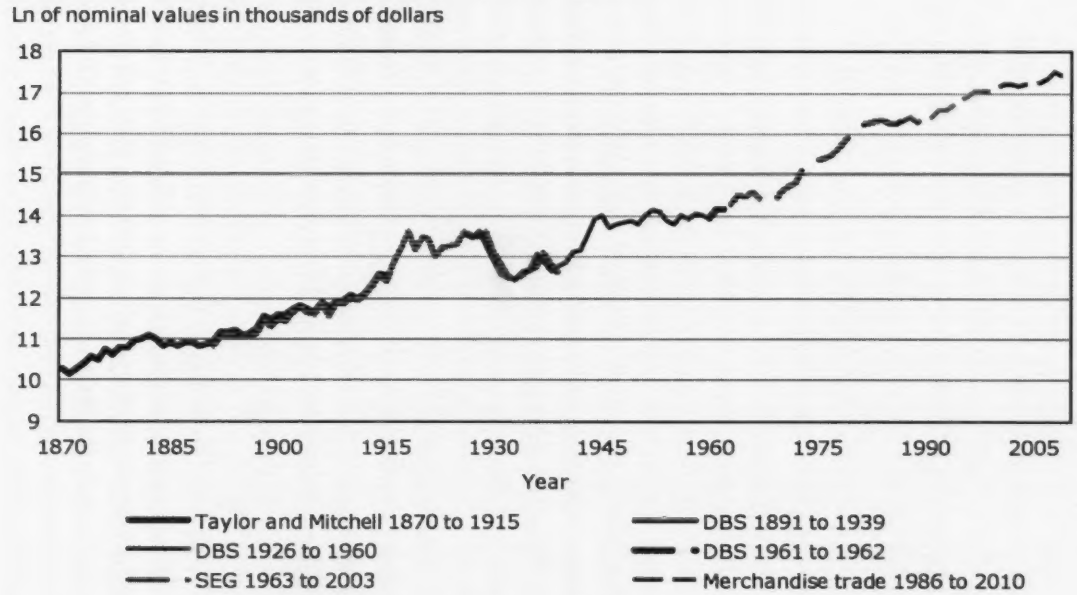
Figure 2
Commodity concordance based on summary export group and summary import group commodity classifications[1] (concluded)

Re-aggregated exports contain	Re-aggregated imports contain
Non-ferrous Metals and Their Products	**Non-ferrous Metals and Their Products**
Copper in Ores, Concentrates and Scraps; Nickel in Ores, Concentrates and Scraps; Radioactive Ores in, Concentrates and Scraps; Other Non-Ferrous Ores in Concentrates and Scraps; Aluminum, Including Alloys; Copper and Alloys; Nickel and Alloys; Zinc, Including Alloys; Other Non-Ferrous Metals and Alloys; Metal Fabricated Basic Products; Aircraft Complete with Engines; Aircraft Engines and Parts;	Aluminum Ores, Concentrates and Scraps; Other Metals in Ores, Concentrates and Scraps; Non-Ferrous Metals and Alloys; Metal Fabricated Basic Products; Aircraft and Parts;
Non-Metallic Minerals and their products	
Crude Petroleum; Natural Gas; Asbestos, Unmanufactured; Other Non-Metallic Minerals; Petroleum and Coal Products; Abrasive Basic Products; Other Non-Metallic Mineral Basic Products;	**Non-Metallic Minerals and their products** Coal; Crude Petroleum; Other Crude Bituminous Substances; Abrasives, Natural; Phosphate Rock; Other Crude Non-Metallic Minerals; Fuel Oil; Petroleum and Coal Products Excluding Fuel Oil; Clay Bricks; Sheet and Plate Glass; Abrasive Products; Natural and Synthetic Gem Stones; Other Non-Metallic Mineral Basic Products;
Chemical and Allied Products	**Chemical and Allied Products**
Chemicals; Fertilizers and Fertilizer Materials; Synthetic Rubber and Plastics; Other Chemical Products;;	Organic Chemicals; Inorganic Chemicals; Other Chemicals and Related Products; Rubber Fabricated Materials;
Miscellaneous Commodities	**Miscellaneous Commodities**
Measured as a Residual and includes items like: Electricity; Television, Communicated and Related Equipment; Office Machines and Equipment; Consumer Products; Special Transactions;	Measured as a Residual and includes items like: Electricity; Television, Communicated and Related Equipment; Office Machines and Equipment; Consumer Products; Special Transactions;

1. Dominion Bureau of Statistics Classification.
Source: Statistics Canada, authors' concordance; Dominion Bureau of Statistics (DBS).

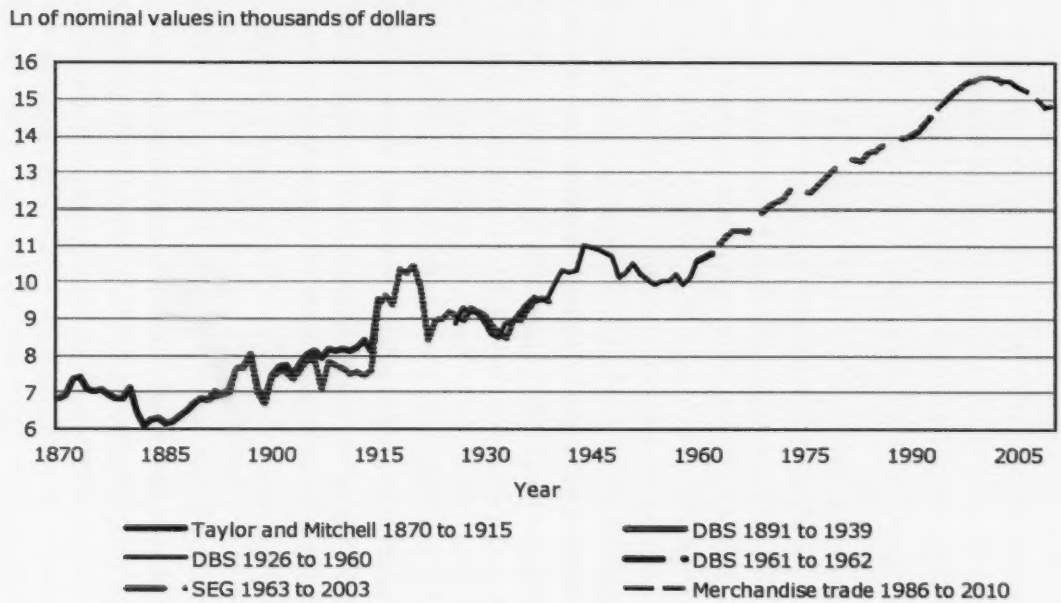
10.2.3 Export data charts

Chart 30
Exports of agricultural products, 1870 to 2010



Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

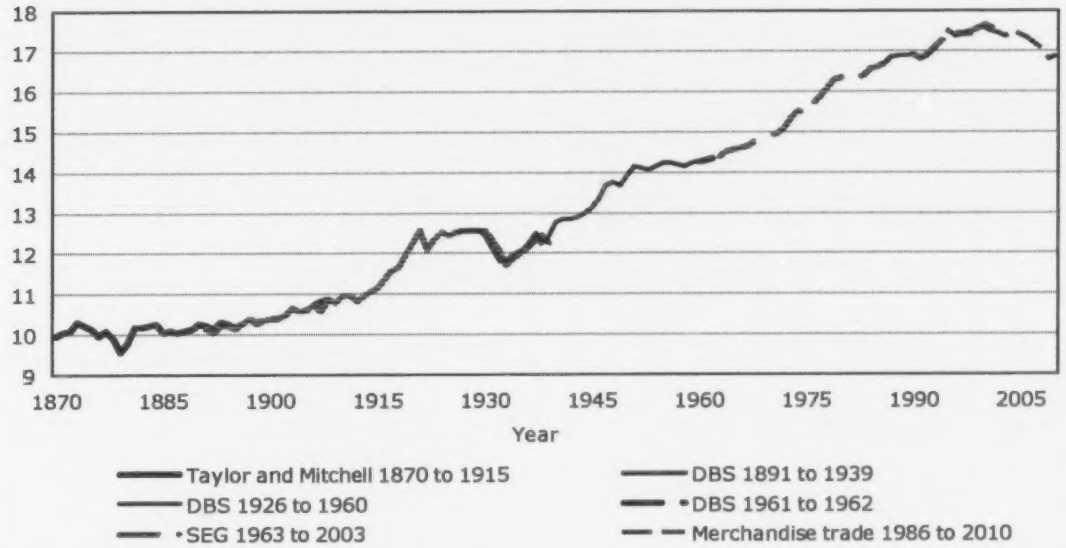
Chart 31
Exports of textile and fiber products, 1870 to 2010



Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 32
Exports of wood and paper products, 1870 to 2010

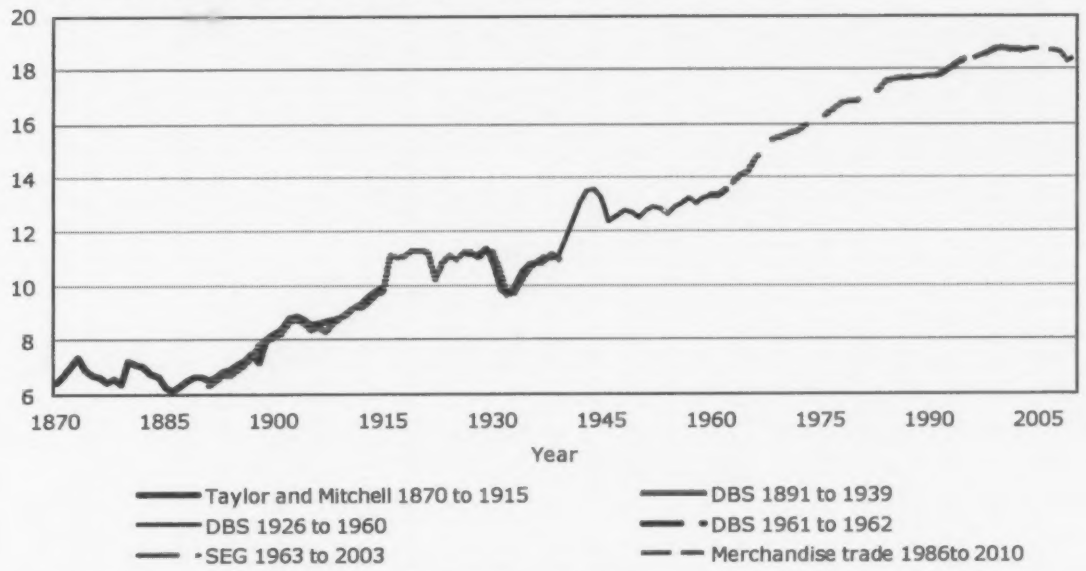
Ln of nominal values in thousands of dollars



Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

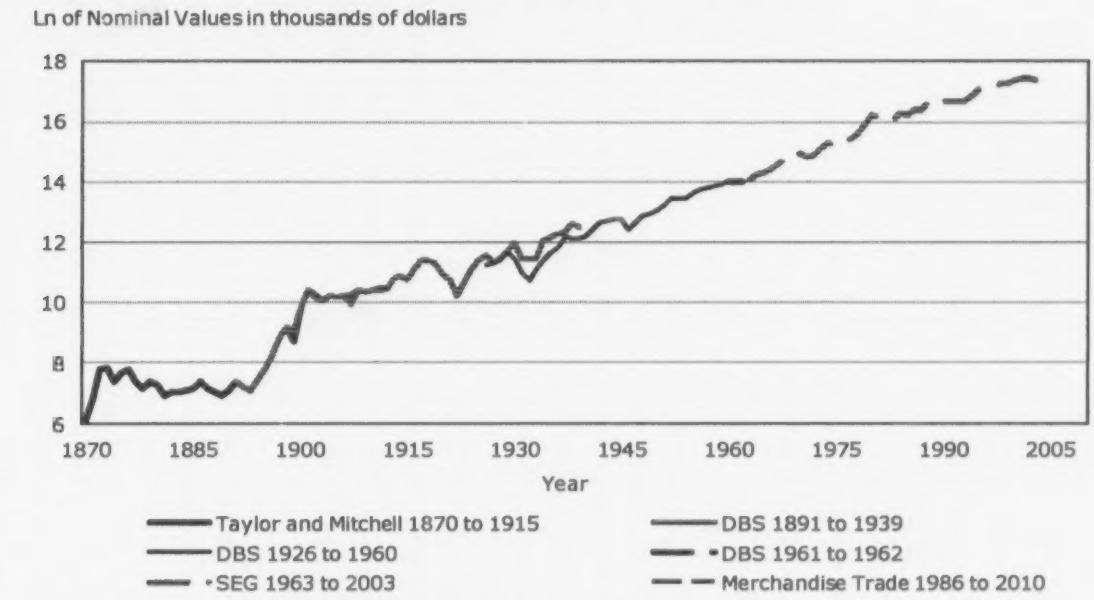
Chart 33
Exports of iron, steel and their products, 1870 to 2010

Ln of nominal values in thousands of dollars



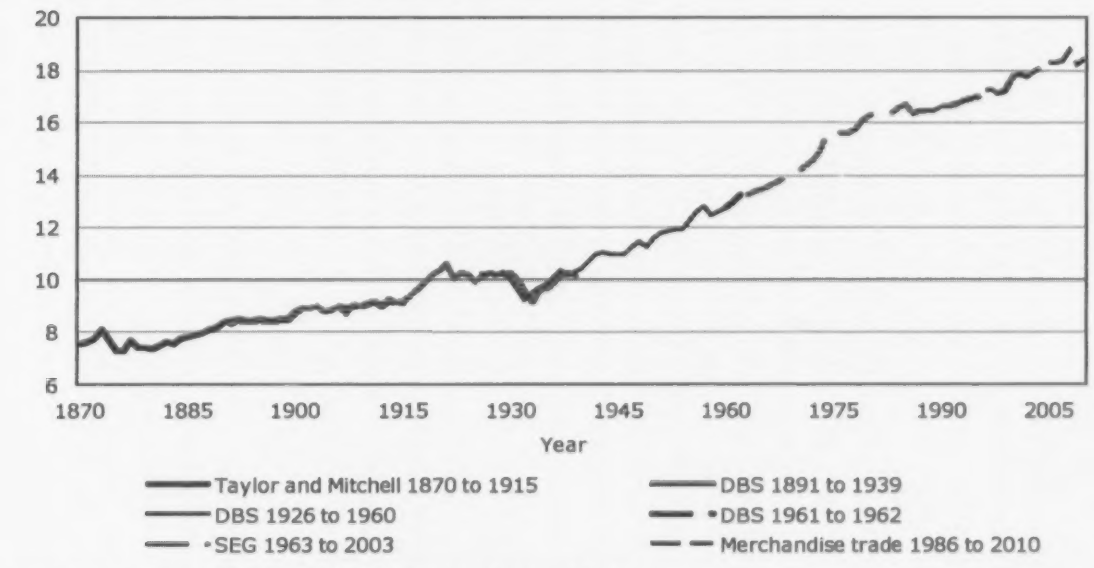
Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 34
Exports of non-ferrous metals and products, 1870 to 2010



Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

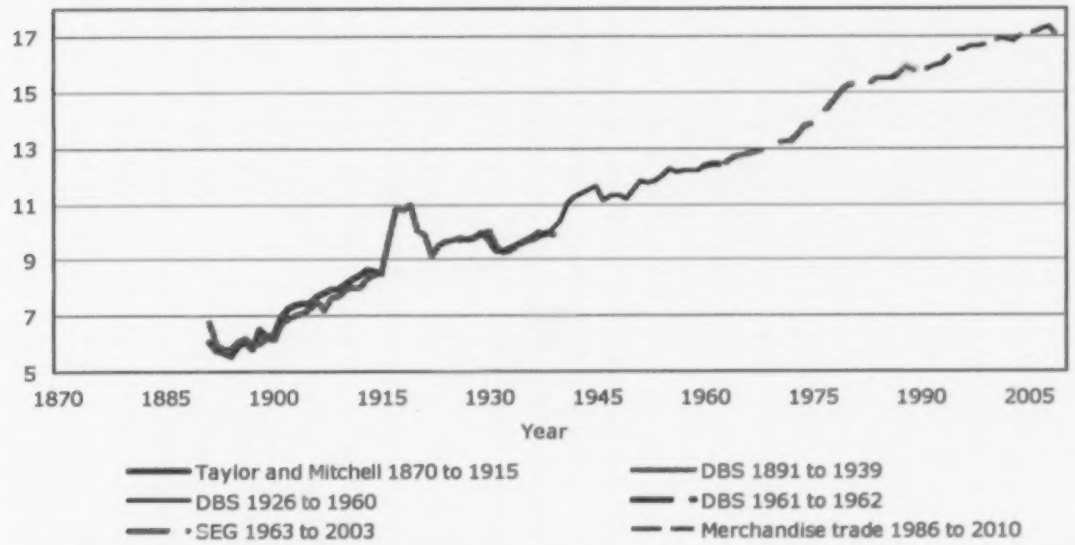
Chart 35
Exports of non-metallic minerals and products, 1870 to 2010



Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 36
Exports of chemicals and fertilizers, 1870 to 2010

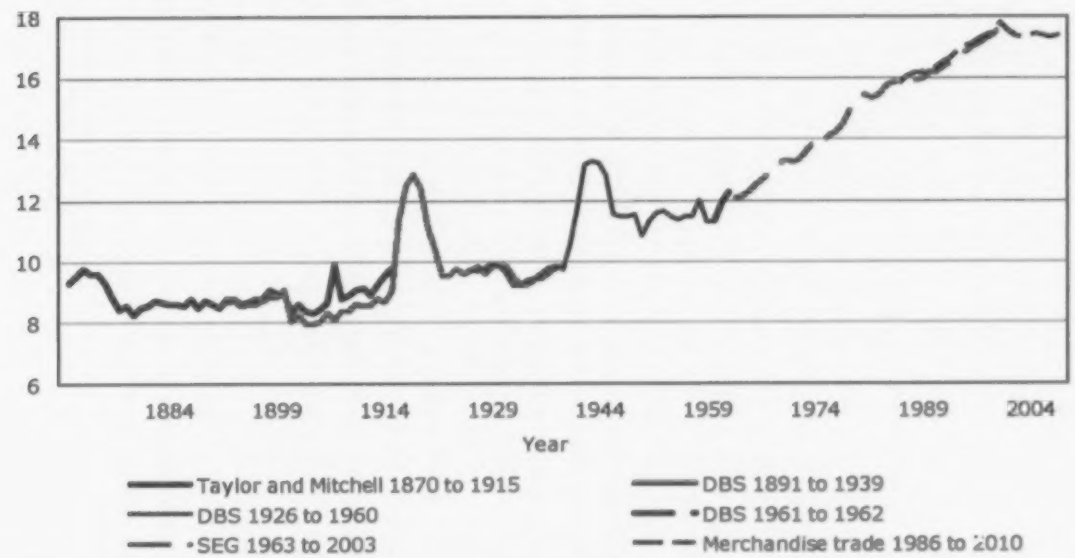
Ln of nominal values in thousands of dollars



Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 37
Exports of miscellaneous products, 1870 to 2010

Ln of nominal values in thousands of dollars



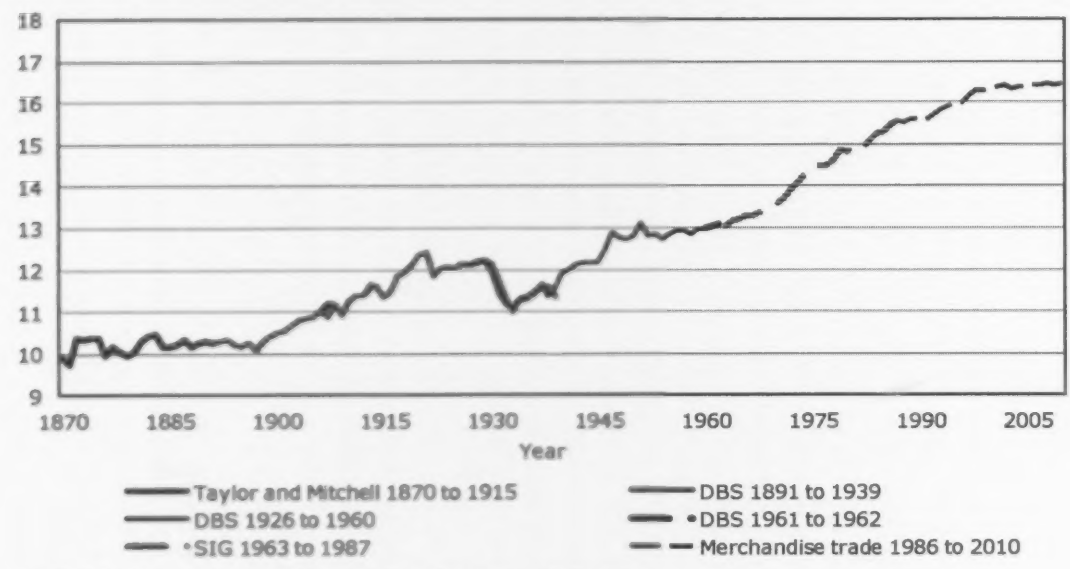
Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

10.2.4 Import data charts

Chart 38
Imports of agricultural products, 1870 to 2010

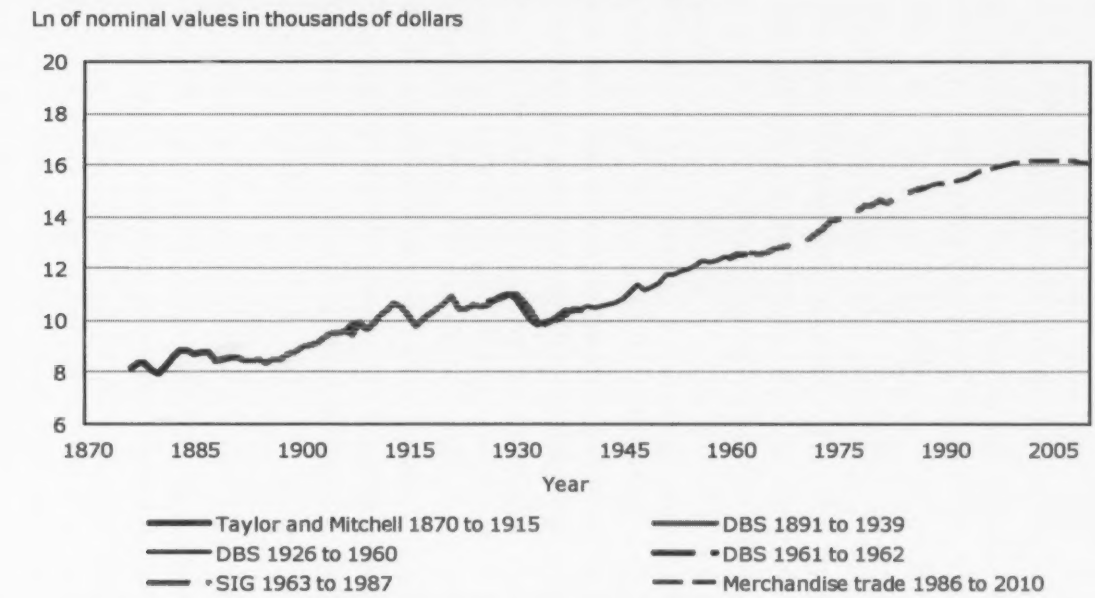
Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 39
Imports of textile and fiber products, 1870 to 2010



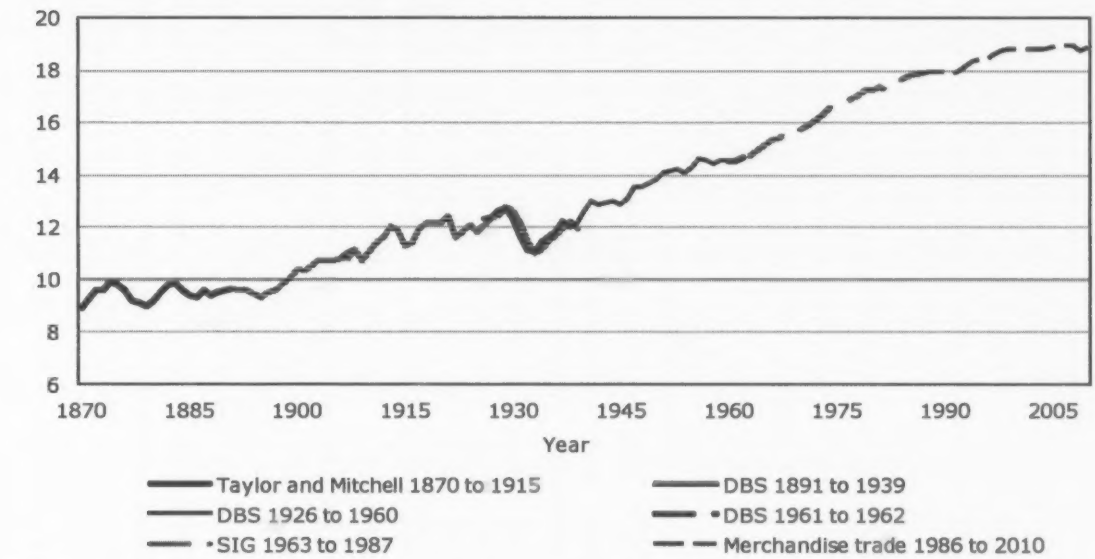
Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 40
Imports of wood and paper products, 1870 to 2010



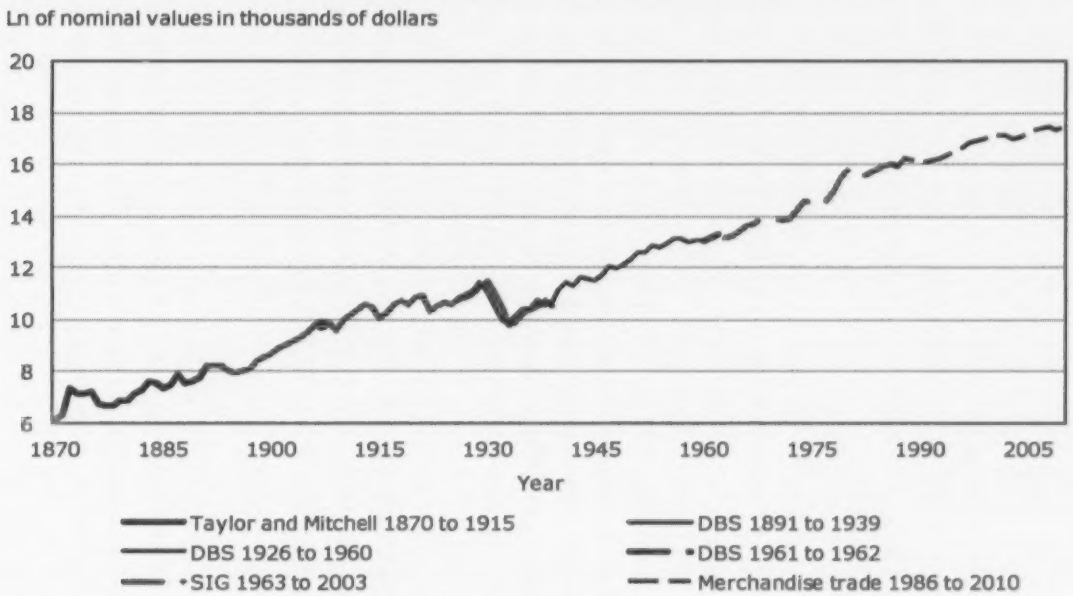
Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 41
Imports of iron, steel and their products, 1870 to 2010



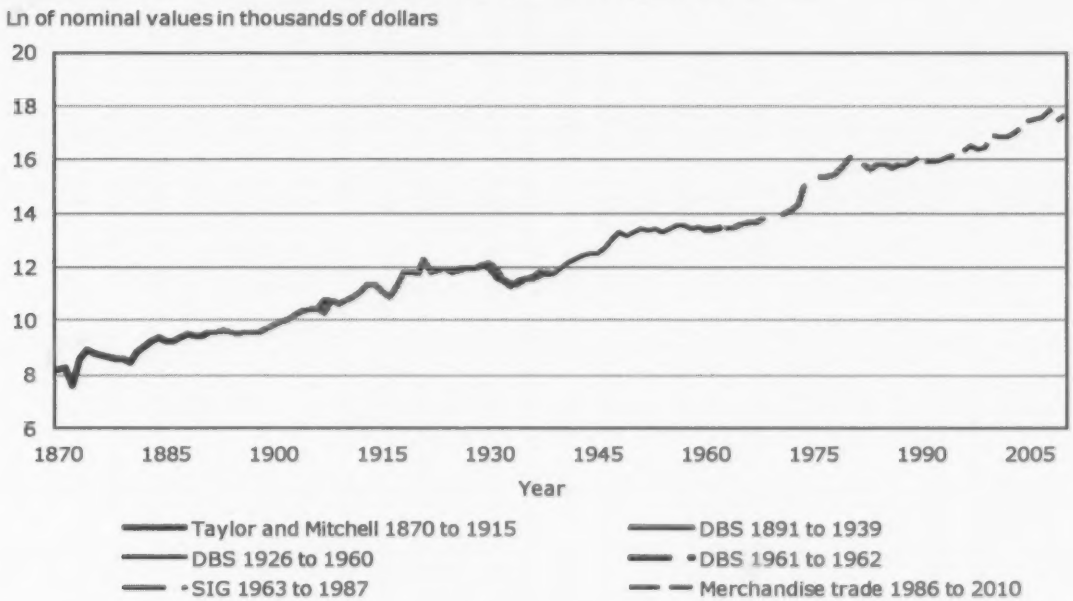
Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 42
Imports of non-ferrous metals and products, 1870 to 2010



Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 43
Imports of non-metallic minerals and products, 1870 to 2010

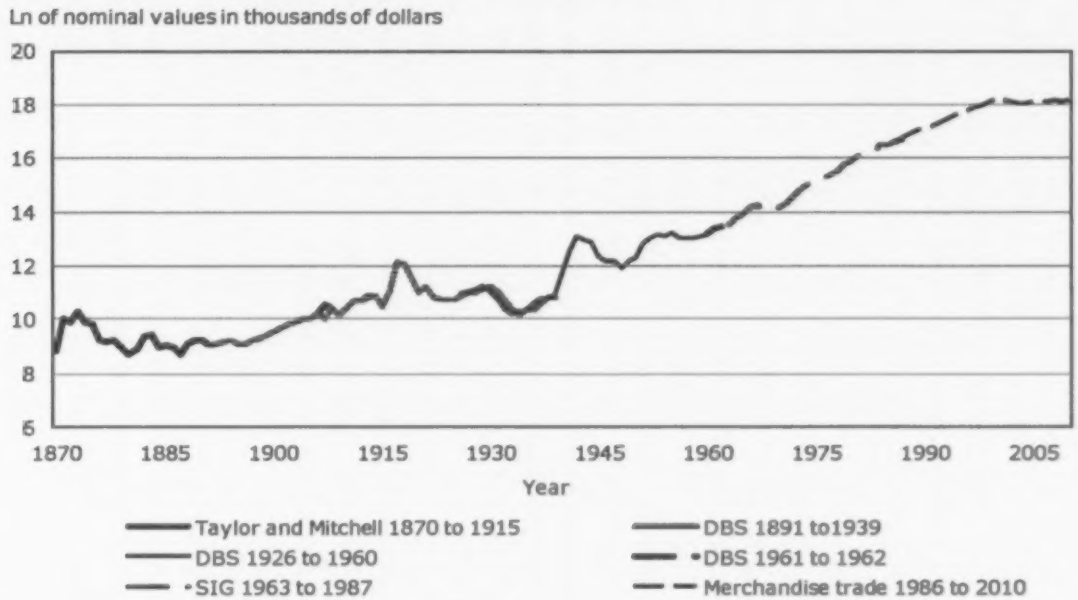


Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 44
Imports of chemical and fertilizer products, 1870 to 2010

Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

Chart 45
Imports of miscellaneous products, 1870 to 2010



Source: Statistics Canada, Taylor and Mitchell, Dominion Bureau of Statistics.

10.3 Historical terms of trade and data quality examination

Taylor and Mitchell and Urquhart and Buckley's *Historical Statistics of Canada* (Historical Statistics) are used as the sources for export and import price indexes from 1870 to 1926. The indexes covering 1870 to 1926 are characterized by a trend increase in Canada's terms of trade. As indicated in the Appendix section 10.1, this paper combines data from different sources to provide a long time period for analysis. The earlier periods use data that are constructed slightly differently: in particular, they tend to use fixed base weights in developing indexes rather than the moving base periods prevalent today.

This section investigates whether the magnitude of the increase in the terms of trade, and the trend itself, are very sensitive to the methodology being used. An earlier observer of price trends in exports from 1900 to 1913 (Viner, 1924) noted that the magnitude of the growth in Canadian export prices can depend importantly on what period is employed as a base.

Taylor and Mitchell used 1900 prices in their study but published detailed information on aggregates in addition to aggregate price indexes for exports and imports. Their dataset spans 1869 to 1915. A gap exists from 1915 to 1961, when the modern set of input–output tables is implemented. In the intervening period, estimates of export and import prices, as well as the terms of trade, can only be based on published aggregates, making it currently impossible to attempt to change the aggregation techniques.

However, the data from Taylor and Mitchell provide an opportunity to examine the effect of changing the aggregation techniques from a fixed-base index to a more modern chained index for the period when terms of trade increases were particularly large. Taylor and Mitchell employ fixed-base price indexes using 1900 as a base period. As a method for assessing the robustness of their estimates to alternative aggregation techniques, the disaggregate data in Taylor and Mitchell is re-aggregated using Tornqvist indexes. Two approaches are used. The first expands the commodity bundle as the variety of trade products expands through time. The second uses only prices available for the entire period for identifiable commodities.

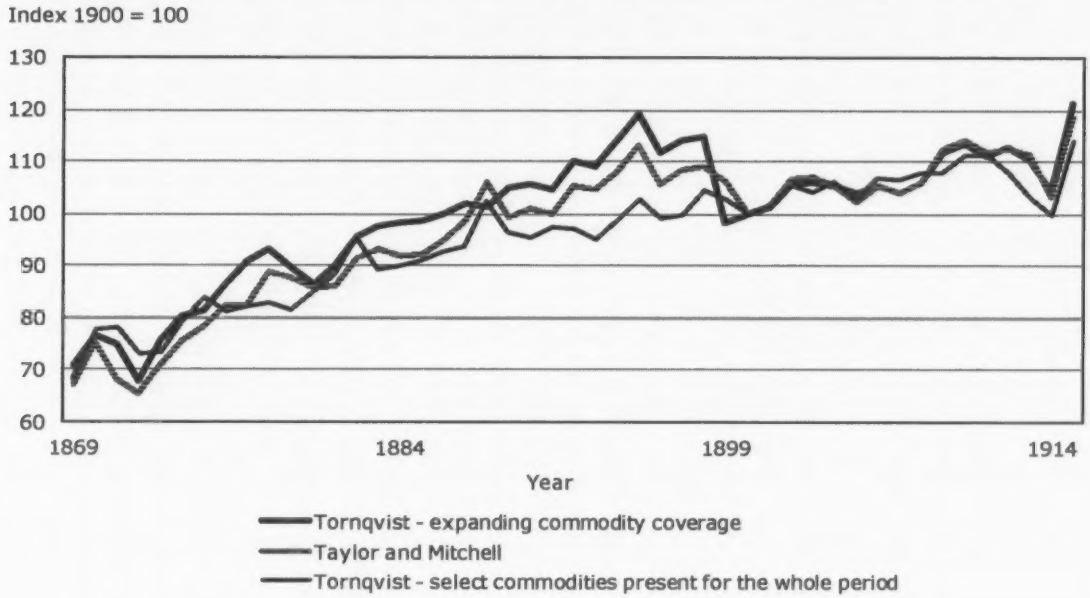
To calculate the indexes, the data in Taylor and Mitchell are edited to facilitate calculating chained indexes. For all commodities except vehicle imports, the data are employed after the point at which major gaps cease to exist. For example, Taylor and Mitchell record values for copper exports in 1869, 1870 and 1875. The next value recorded is in 1889, after which there is an unbroken record. The year 1889 is therefore taken as the first year for which copper exports are included in the Tornqvist index. Similar adjustments are made for other commodities where the time series exhibit noteworthy absences through time. In the event that a single data point is missing, the average of the preceding and trailing years are used to interpolate the missing data point. The one exception is imports of vehicles. Taylor and Mitchell do not record import values from 1879 to 1883. For the missing years, the value of imports is estimated using a linear interpolation.

Comparing the Tornqvist indexes for the terms of trade with the fixed-base estimates in Taylor and Mitchell produces chained index estimates that are approximated by their fixed-base counterpart produced by Taylor and Mitchell. Over the period spanning 1869 to 1915, Taylor and Mitchell's fixed-base estimate grew at an annual rate of 1.25% versus 1.18% for the Tornqvist index that expands the commodity bundle through time and 1.12% for the Tornqvist index that uses only those commodities present in all years. In short, there are only minor differences in the growth rate over the entire period.

In this paper, we use Taylor and Mitchell's index. We chose not to replace Taylor and Mitchell's fixed-base index with the chained index in the paper for two main reasons. First, our chained index is based in part on interpolations, and on pre-calculated fixed-base aggregates. So, while

there is some adjustment to relative price and quantity movements, we do not view the improvement as producing a sufficiently different result to warrant implementation. Second, the data produced by Taylor and Mitchell have been widely used and are available to researchers. Its use makes our study more comparable with historical works for Canada. Moreover, without an ability to properly begin with source data for aggregation, it becomes risky to argue that the historical narrative about the terms of trade necessarily needs revision. We take the cautious approach, and employ the historical series produced by Taylor and Mitchell.

Chart 46
Terms of trade 1869 to 1915; alternative aggregation to Taylor and Mitchell

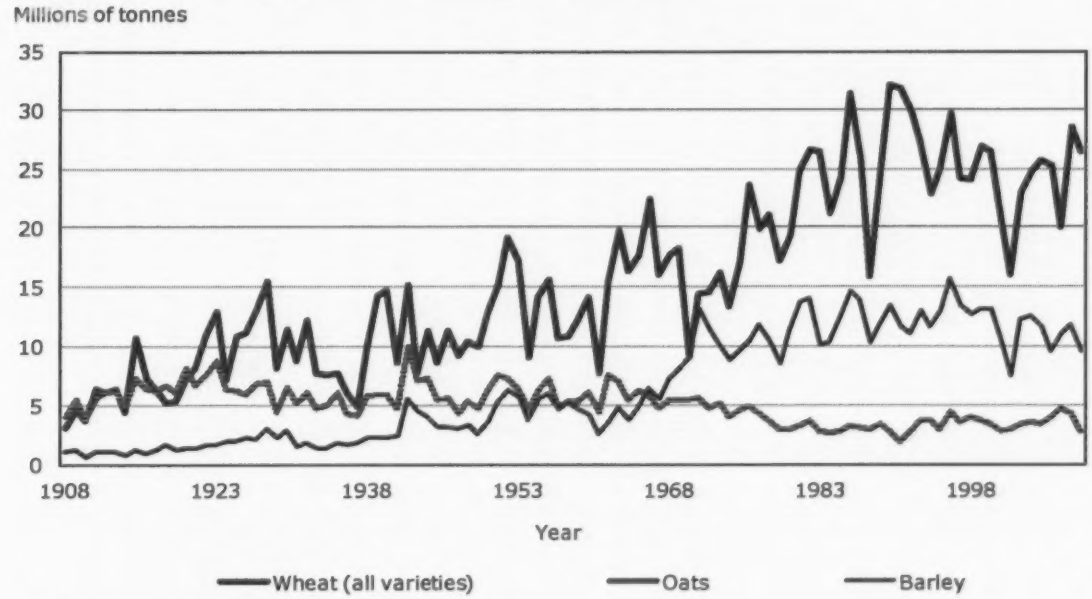


Source: Authors' calculations based on Taylor and Mitchell.

10.4 Long-run production of Canadian staples

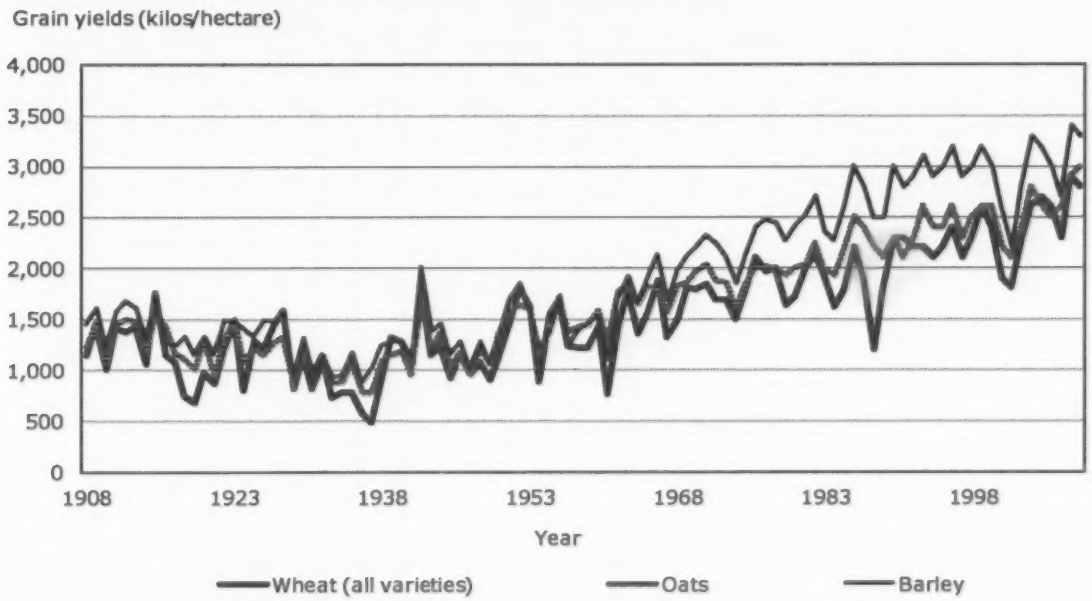
10.4.1 Agriculture

Chart 47
Production of wheat, oats and barley, 1908 to 2009



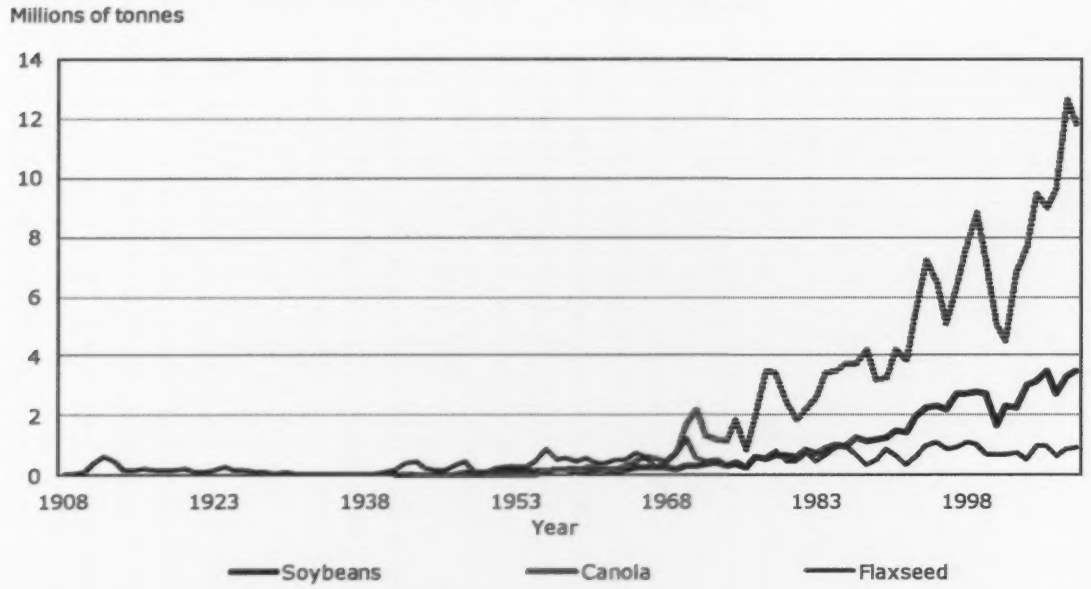
Source: Statistics Canada, CANSIM table 001-0010.

Chart 48
Grain yields for wheat, oats and barley 1908 to 2009



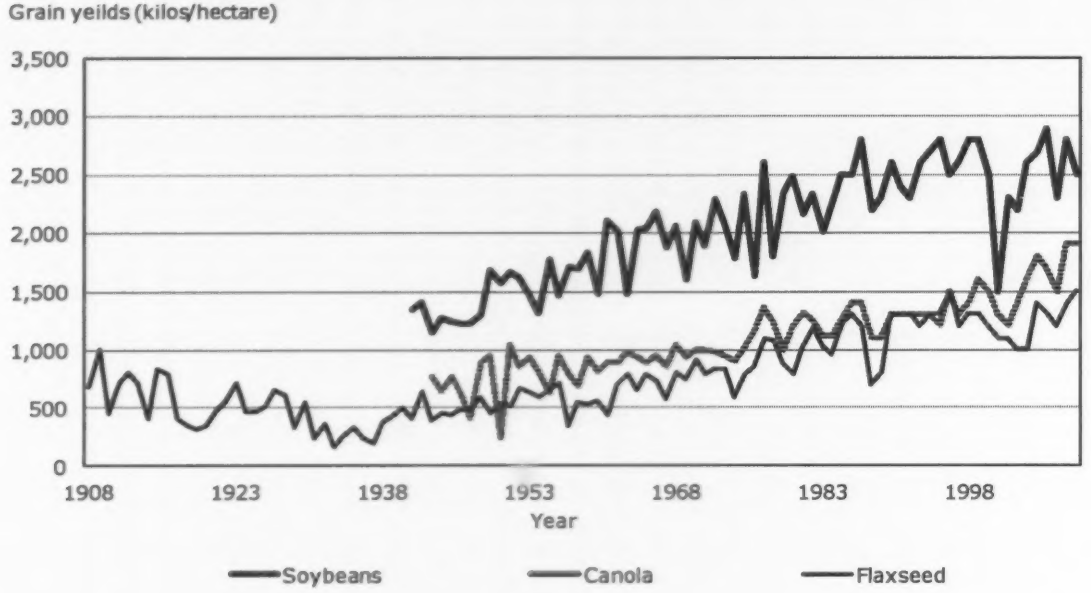
Source: Statistics Canada, CANSIM table 001-0010.

Chart 49
Soybean, canola and flaxseed production, 1908 to 2009



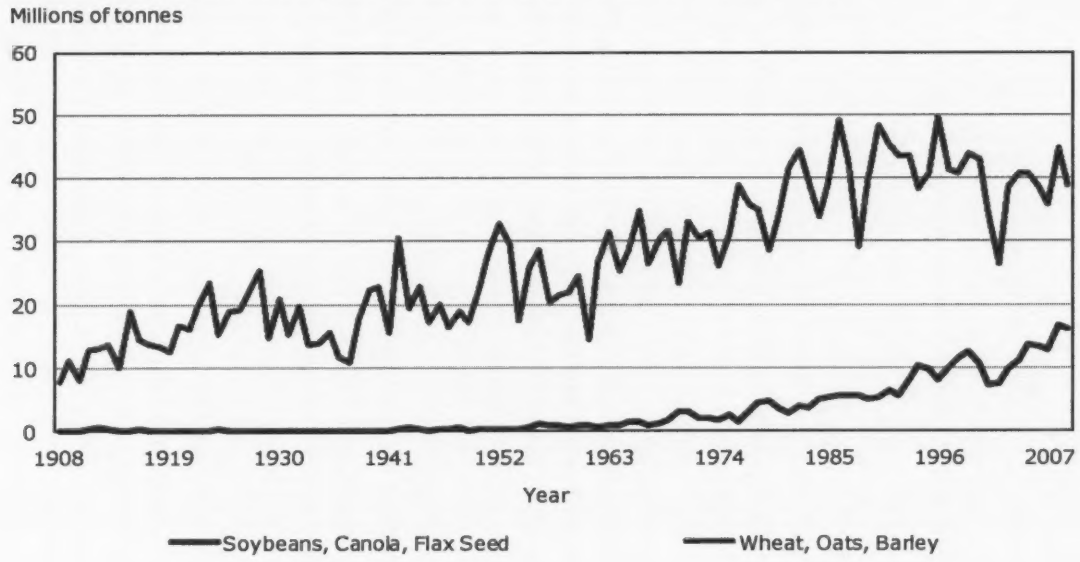
Source: Statistics Canada, CANSIM table 001-0010.

Chart 50
Seed yields, 1908 to 2009



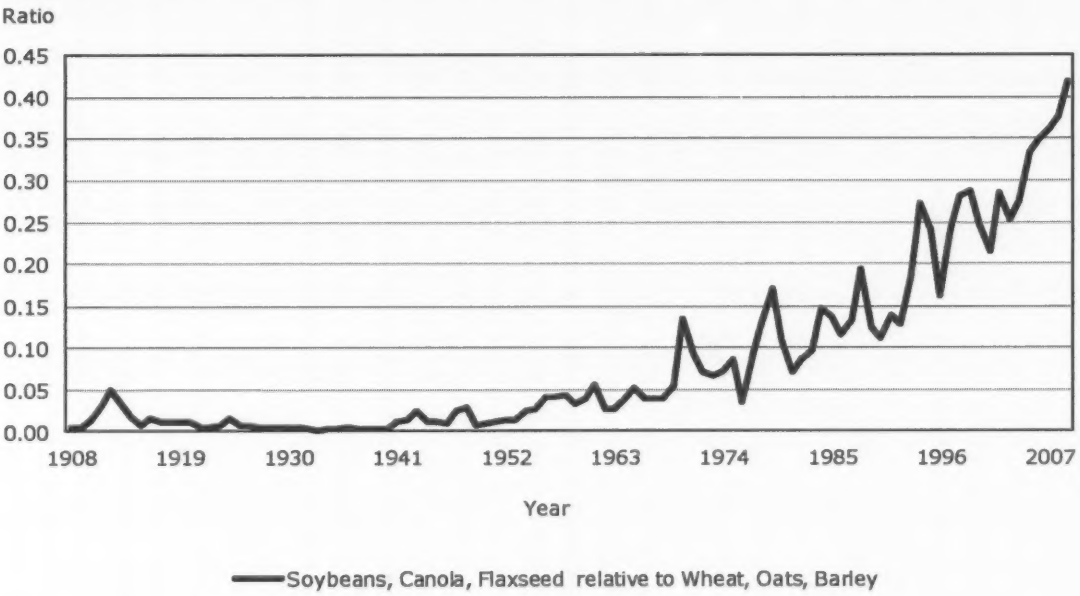
Source: Statistics Canada, CANSIM table 001-0010.

Chart 51
Field crop versus seed products, select products, 1908 to 2009



Source: Statistics Canada, CANSIM table 001-0010.

Chart 52
Production of soybeans and canola relative to wheat, oats and barley, 1908 to 2009



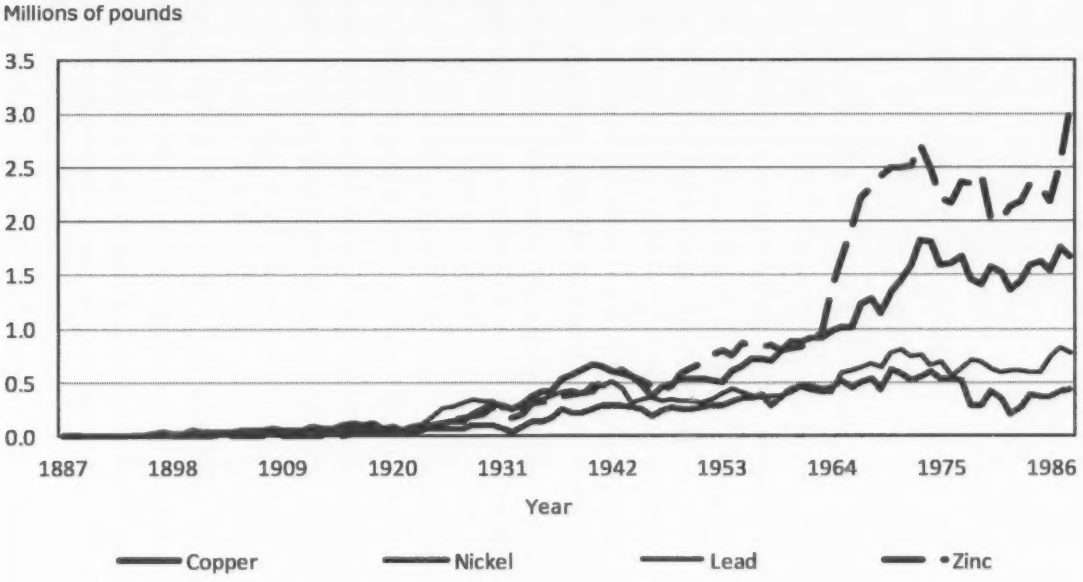
Source: Statistics Canada, authors' calculations based on CANSIM table 001-0010.

10.4.2 Metals

Chart 53
Gold and silver production, 1886 to 2009

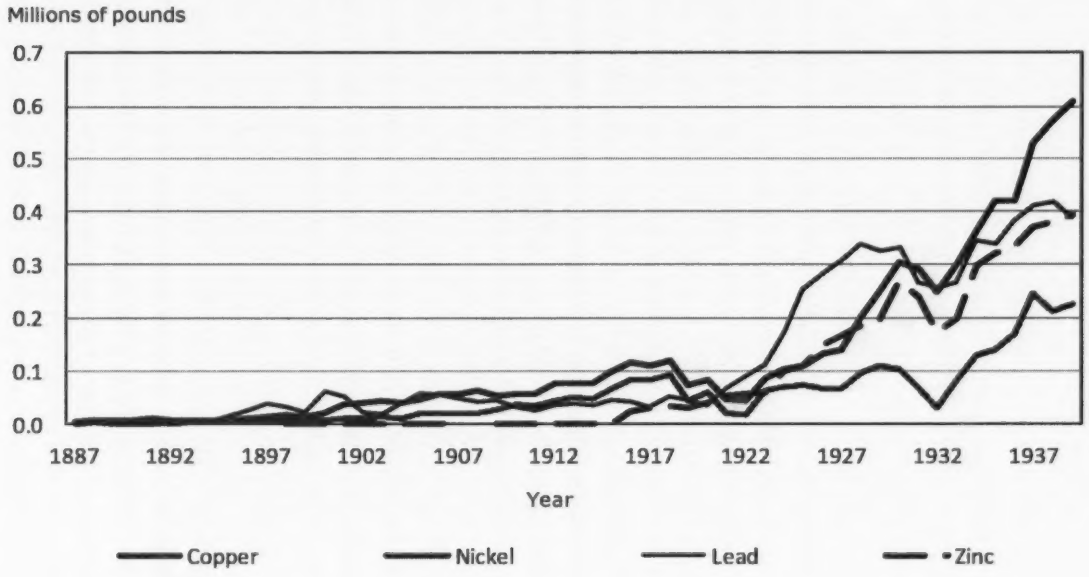
Sources: Historical Statistics and CANSIM table 152-0001.

Chart 54
Copper, nickel, lead and zinc production, 1886 to 2009



Sources: Historical Statistics and CANSIM table 152-0001.

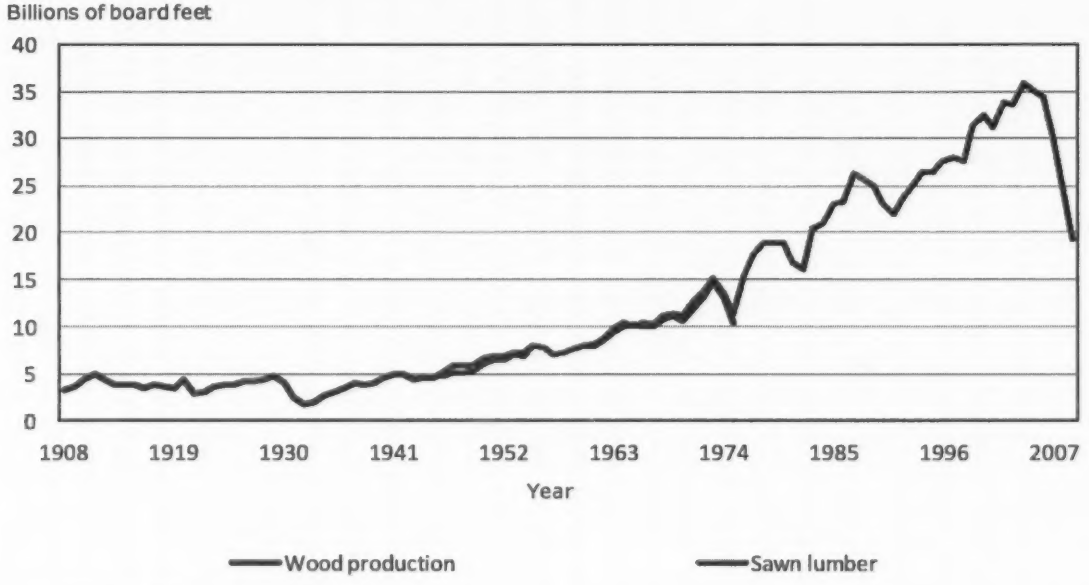
Chart 55
Copper, nickel, lead and zinc production, 1886 to 1939



Source: Historical Statistics.

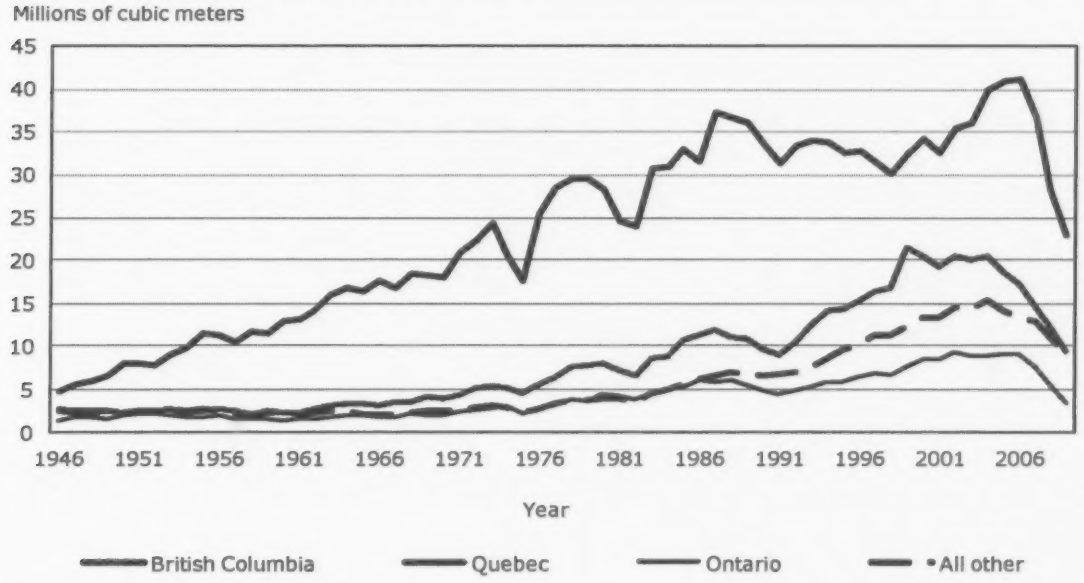
10.4.3 Forestry

Chart 56
Wood production and sawn lumber, 1908 to 2009



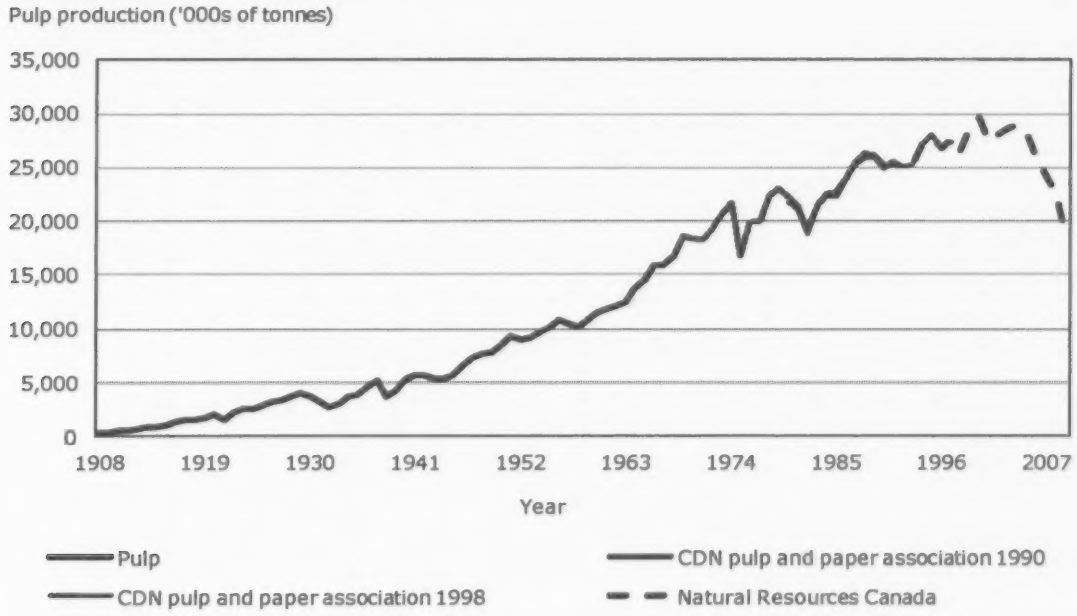
Source: Historical Statistics and CANSIM table 303-0009.

Chart 57
Sawn lumber by province, 1946 to 2009



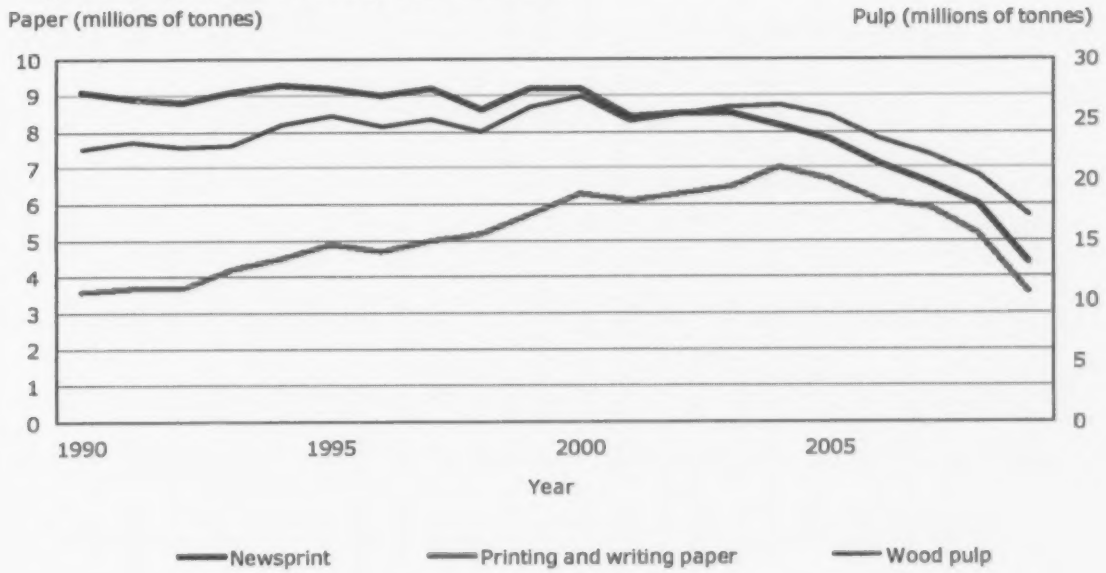
Source: Statistics Canada, CANSIM table 303-0009.

Chart 58
Pulp production, 1908 to 2009



Note: Pulp description may not be perfectly consistent between publications.
Source: Historical Statistics, Canadian Pulp and Paper Association and Natural Resources Canada.

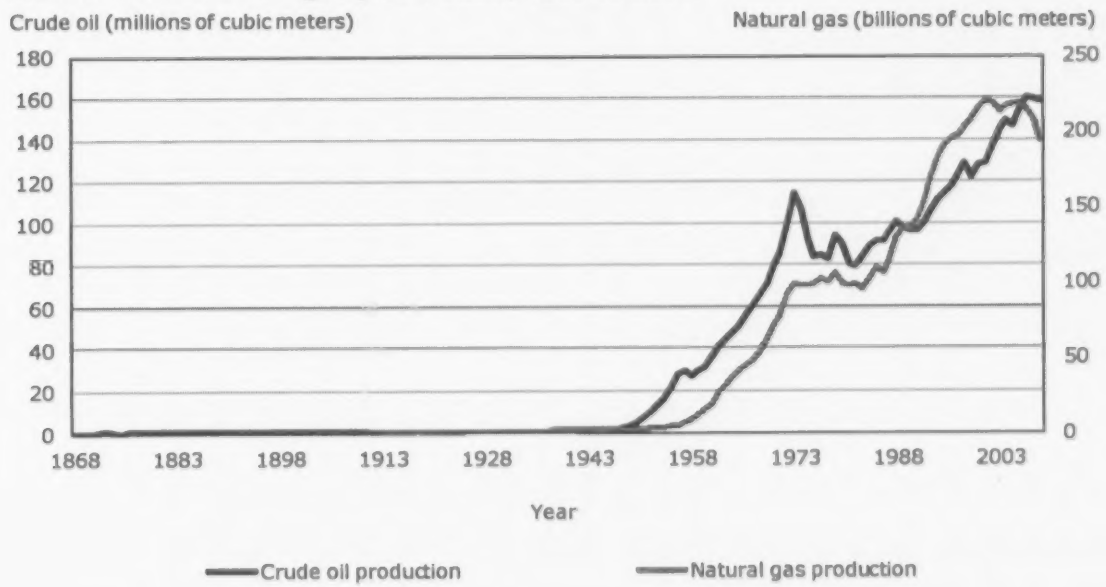
Chart 59
Pulp and paper production, 1990 to 2009



Source: Natural Resources Canada.

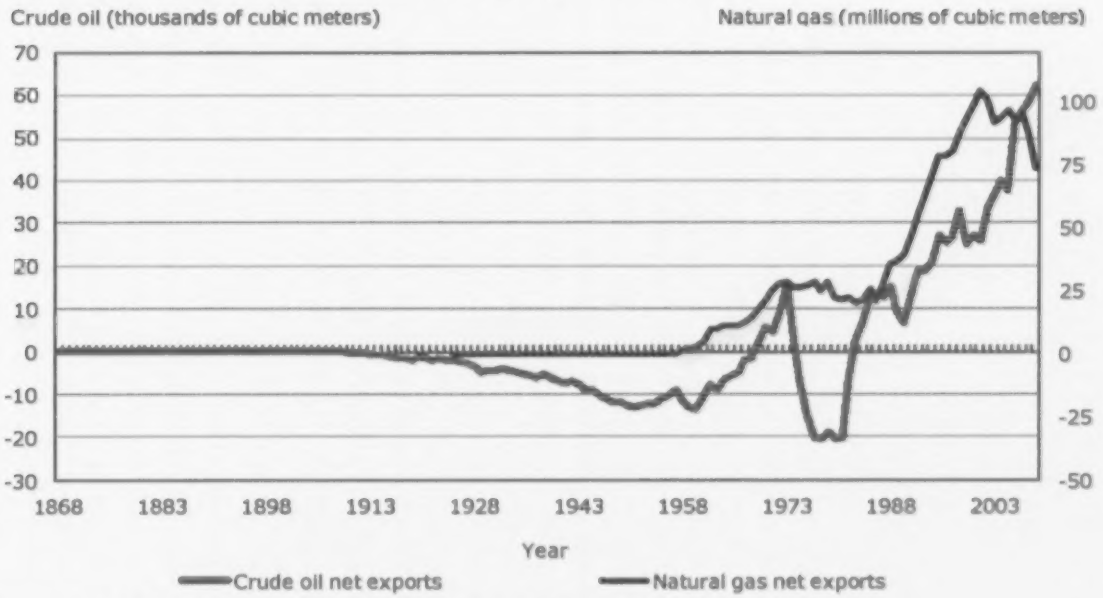
10.4.4 Energy

Chart 60
Crude oil and natural gas production, 1868 to 2009



Source: Historical Statistics and CANSIM tables 126-0001, 126-0002, 131-0001 and 131-0003.

Chart 61
Net exports of crude oil and natural gas, 1886 to 2009



Source: Historical Statistics and CANSIM tables 126-0001, 126-0002, 131-0001 and 131-0003.

10.5 Derivation of the trading gain and real GNI

Understanding the relationship between various real income concepts guides the choice of method for deflating the net export term when producing a measure of real income. Net exports, in nominal terms, are part of the stream of income that is generated in the production process and that can be used to purchase product. The most comprehensive price index that can be used to create a volume index out of this income stream is the deflator for final demand expenditures. Using it to deflate the income stream derived from trade or from foreign remittances is equivalent to assuming that the net income stream from trade will be used to enhance purchases across the various final demand categories in the same proportion as existing expenditures (Reinsdorf, 2010).

Using this final demand deflator enables isolation of the impact of the terms of trade. To see this:

Following Kohli, (2004), let $d\ln(P_{Y,t/t-1})$ be the Tornqvist index for the GDP deflator, which is written as

$$d\ln(P_{Y,t/t-1}) = \sum_i \bar{v}_{i,t/t-1} d\ln(P_{i,t/t-1}) \quad i = FDE, X, M$$

where *FDE*, *X* and *M* represent final domestic expenditures, exports and imports; and

$$v_{i,t} = \frac{\gamma_i}{GDP} \quad \gamma_i = FDE, X, M \text{ ; and}$$

$$\bar{v}_{i,t/t-1} = \frac{(v_{i,t} + v_{i,t-1})}{2} \quad i = FDE, X, M .^{9}$$

Real GDP growth is defined as nominal GDP growth minus GDP deflator growth:

$$d\ln(y_{Y,t/t-1}) = d\ln(GDP_{t/t-1}) - d\ln(P_{Y,t/t-1}). \tag{5}$$

Real GDI deflator growth is equal to FDE deflator growth:

$$d\ln(P_{GDI,t/t-1}) = d\ln(P_{FDE,t/t-1})$$

Real GDI growth is equal to nominal GDP growth minus FDE price growth:

$$d\ln(y_{GDI,t/t-1}) = d\ln(GDP_{t/t-1}) - d\ln(P_{GDI,t/t-1}).$$

9. The GDP deflator also includes inventories and a statistical discrepancy. These are omitted from the analytical section.

The trading gains from relative price changes will be defined here as the difference between the real GDI growth and real GDP growth:

$$d\ln(T_{t/t-1}) = d\ln(y_{GDI,t/t-1}) - d\ln(y_{Y,t/t-1}), \tag{6}$$

which reduces to the difference between GDP deflator growth and GDI deflator growth:

$$d\ln(T_{t/t-1}) = d\ln(P_{Y,t/t-1}) - d\ln(P_{GDI,t/t-1}).$$

By rearranging equation (6), real GDI growth is equal to real GDP growth plus trading gains:

$$d\ln(y_{GDI,t/t-1}) = d\ln(y_{Y,t/t-1}) + d\ln(T_{t/t-1}). \tag{7}$$

To generate a more intuitive expression, define

- terms of trade growth as

$$d\ln(ToT_{t/t-1}) = d\ln(P_{X,t/t-1}) - d\ln(P_{M,t/t-1});$$

- growth in traded prices as

$$d\ln(P_{T,t/t-1}) = \frac{1}{2}\left(d\ln(P_{X,t/t-1}) + d\ln(P_{M,t/t-1})\right); \text{ and}$$

- growth in the real exchange rate, which captures changes in the purchasing power of the domestic economy that are generated from changes in net export income, as

$$d\ln(E_{t/t-1}) = d\ln(P_{T,t/t-1}) - d\ln(P_{FDE,t/t-1}).$$

Using these definitions and equation (7), it can be shown that the trading gains measured here are the weighted sum of the real exchange rate and terms of trade movements:

$$d\ln(T_{t/t-1}) = (\bar{v}_X - \bar{v}_M)\{d\ln(E_{t/t-1})\} + \frac{1}{2}(\bar{v}_X + \bar{v}_M)\{d\ln(ToT_{t/t-1})\}. \tag{8}$$

By combining (7) and (8), it is evident that real GDI growth is real GDP growth plus the weighted sum of adjustments for changes in the real exchange rate and the terms of trade:

$$d\ln(y_{GDI,t/t-1}) = d\ln(y_{Y,t/t-1}) + \left[(\bar{v}_X - \bar{v}_M)\{d\ln(E_{t/t-1})\} + \frac{1}{2}(\bar{v}_X + \bar{v}_M)\{d\ln(ToT_{t/t-1})\}\right]. \tag{9}$$

The weights attached to changes in the real exchange rate and the terms of trade have economic significance. The real exchange rate weight, $(\bar{v}_X - \bar{v}_M)$, is positive (negative) when the trade balance is in surplus (deficit), while its magnitude captures the size of the surplus (deficit) relative to nominal GDP—the net trade balance. The weight attached to terms of trade growth, $\frac{1}{2}(\bar{v}_X + \bar{v}_M)$, is the average value of trade as a proportion of nominal GDP—the gross trade balance. As a result, real GDI in countries that are more open to trade is more susceptible to shifts in terms of trade, and a larger trade imbalance makes real GDI more susceptible to real exchange rate movements.

Of the two relative price ratios, the terms of trade is the more important for understanding changes in purchasing power. It is subject to larger fluctuations in Canada than the real exchange rate, and has a larger impact because it is related to trade openness. The impact of the real exchange rate effect is proportional to the net trade balance in GDP, and so it has a much smaller impact on real income fluctuations, since

$$\left(\left| (X-M)/GDP \right| \leq (X+M)/GDP \right). \tag{10}$$

Movements in the terms of trade and the real exchange rate are not independent of each other. For example, a nominal exchange rate depreciation can worsen a country's terms of trade and simultaneously improve its real exchange rate. They can reinforce or dampen each other's effects depending on the type of price movements and their sources.

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Endnotes

In this set of endnotes, the following abbreviations are used:

CANSIM represents the statistical tables available from Statistics Canada and deposited in research libraries across Canada.

EA for Easterbrook, W.T., and H.G.J. Aitken. 1963. *Canadian Economic History*. Toronto: Macmillan.

H for Horning, F.J. 1940. An Economic and Statistical Study Submitted on behalf of International Utilities Corporation.

HS for the historical statistics published on Statistics Canada's website and originally published as Urquhart, M. and F. Buckley (eds). 1983. *Historical Statistics of Canada*. Ottawa: Statistics Canada.

M for MacIntosh, W.A. 1939. The Economic Background of Dominion-Provincial Relations Appendix III of the Royal Commission Report on Dominion-Provincial Relations. Carleton Library no. 13. (edited and introduced by J.H. Dales) Toronto: McClelland and Stewart.

TM for Mitchell, H., and K. Taylor. 1931. *Statistical Contributions to Canadian Economic History*. Vol. II. Toronto: The Macmillan Company of Canada Limited.

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a M, p. 18

b M, p. 37

c EA, p. 396

d M, p. 40

e HS, series on wheat production

f M, p. 40

g H, c. 19

h H, c. 19, see HS series L177

i H, T15, T18

j H, T17

k M, p. 41

l EA, p. 487

m EA, p. 488

n EA, p. 488

o EA, p. 519

p	EA, p. 490
q	EA, p. 540
r	M, p. 91
s	M, p. 79
t	HS, p. 362
u	HS, p. 362
v	HS, p. 356
w	HS, p. 363
x	HS, p. 367, authors' calculations
y	HS, p. 412
z	EA, p. 538
aa	EA, p. 539
bb	HS, series P1–6,
cc	Caves and Holten, 1959, p. 386
dd	CANSIM tables 126-0001 and 126-0002 (converted using 1 barrel = 0.158910 cubic metres from the Government of Alberta Department of Energy website)
ee	CANSIM tables 126-0001 and 126-0002
ff	CANSIM tables 126-0001 and 126-0002
gg	CANSIM tables 131-0001 and 131-0003 (converted using 100 cubic metres = 0.0353 million cubic feet from the Government of Alberta Department of Energy website)
hh	CANSIM table 303-0009
ii	CANSIM table 303-0009
jj	CANSIM table 380-0027
kk	CANSIM table 380-0027
ll	Natural Resources Canada website
mm	CANSIM tables 380-0027 and 228-0003
nn	CANSIM table 303-0009
oo	Cranstone, 2002
pp	CANSIM table 152-0001
qq	M, p. 38

rr	M, p. 38
ss	M, p. 38
tt	M, p. 38
uu	TM, p. 4
vv	TM, p. 4
ww	HS, series M228, p. 9, p. 3
xx	HS, series L172–173
yy	M, p. 72
zz	M, p. 77
aaa	M, p. 76
bbb	M, p. 115
ccc	M, p. 117
ddd	M, p. 76